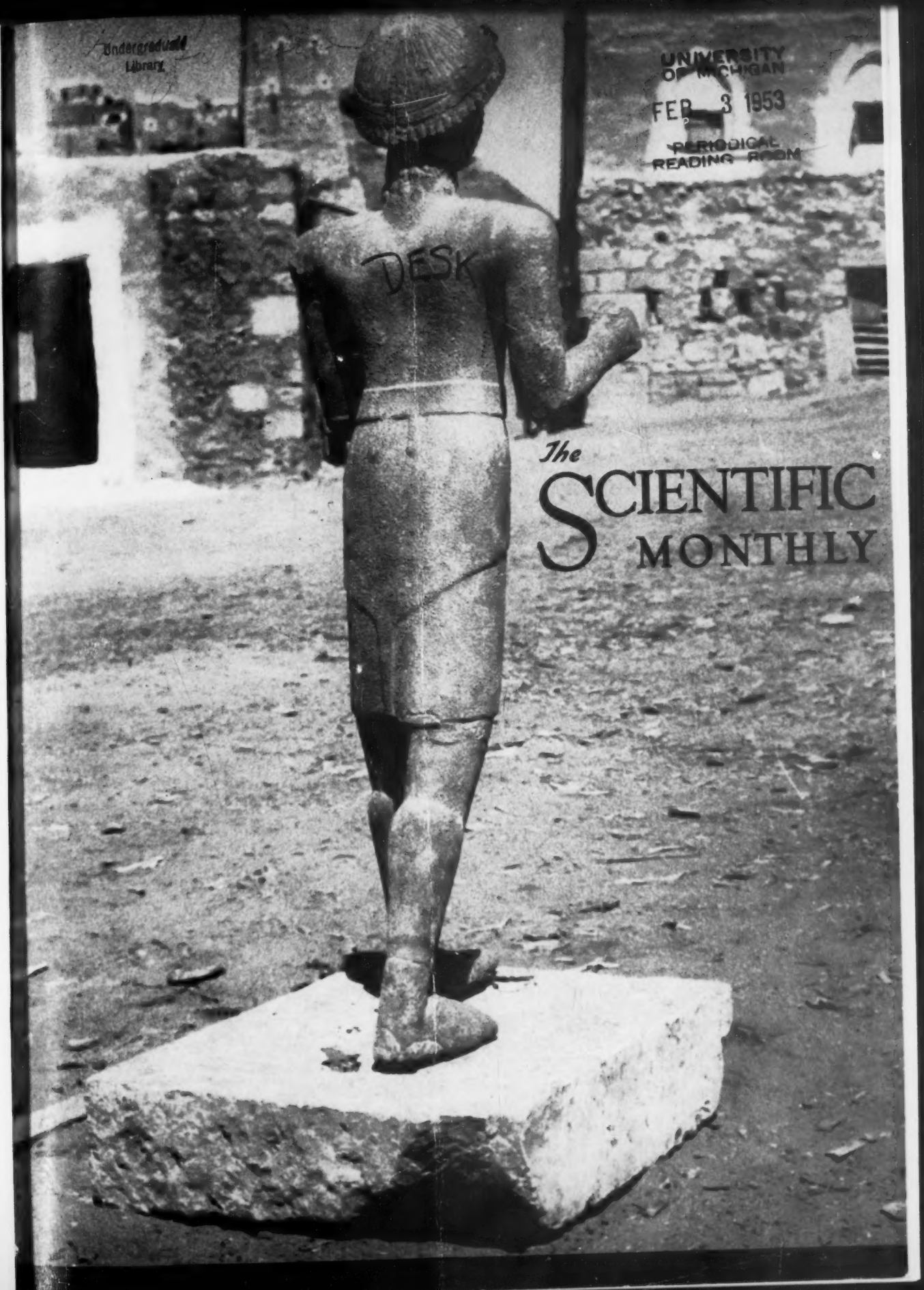

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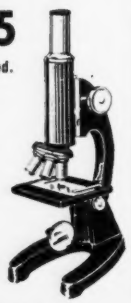

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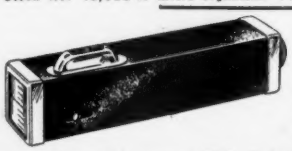

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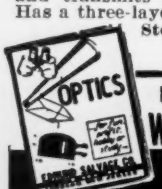

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THE SCIENTIFIC MONTHLY

VOL. LXXVI JANUARY 1953 NO. 1

Contents

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Science and Technology

(From the Month's News Releases)

Library of Gem Stones

Thirty precious and semiprecious stones, including ruby, sapphire, emerald, and opal, together with easy-to-read tables showing hardness, refractory index, occurrence, and other information, are bound as a book, which costs $5.00 with rough stones, $9.00 with polished.

Dip Needles

A dip needle that gives swing readings and a self-orientating dip needle may be used for locating buried magnetic ore such as magnetite, pyrrhotite, hematite, and siderite. They may also be used for locating pipes, sunken ships, iron-bound chests, coins, or artifacts hidden in the earth or under water.

Clogging Eliminated

A product that liquefies organic wastes in septic tanks provides all-year-round trouble-free septic tank operation in a single application per year. Metal pipes, porcelain, or cement blocks are not affected by it, and its use is as simple as pouring water down a toilet bowl.

New Chart

An X-ray spectrograph chart $17\frac{1}{2}'' \times 22\frac{1}{2}''$, showing characteristic secondary X-ray beams for elements from Sodium (atomic #11) to Uranium (atomic #92), is available free from the Research & Control Instruments Division, North American Philips Company, Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Never Drips

A plastic pouring spout with a drain-back channel is fitted with a snap-on cap and is sized to fit standard plug-cap milk bottles. A special ring adapts it to odd-sized bottles. Easy to clean and inexpensive.

Multipurpose Flask

A new 500-ml Kjeldahl flask is made with a removable neck fitted with a standard taper joint. This allows titrations to be carried on in the bulb; acetylations, too, can be done in the digestion flask, and by removing the neck and substituting a refluxing condenser with a standard taper joint, chemists can reflux prior to actual digestion.

Kinorama

The National Bureau of Standards, in cooperation with the Navy Bureau of Aeronautics, has developed a device with which a pilot can evaluate the guidance provided by a system of approach lights without leaving the ground. The kinorama allows the pilot to see an approach-light configuration speeding by him just as he would in flying over it in fog. Not a substitute for actual flight testing for the final approval of a system, it is, nevertheless, inexpensive, objective, free from hazards, and not dependent upon the occurrence of fog.

New Eyes for the Needy

Old eyeglasses (with or without lenses), broken watches, bits and pieces of earrings, necklaces, and cuff links or other cast-offs of gold or silver are welcomed by New Eyes for the Needy, Inc., Short Hills, N. J. A nonprofit, volunteer institution that began its operations in 1933, the organization distributes new glasses and artificial eyes with a minimum of red tape. Simple magnifying (old age) glasses, simple near-sighted glasses, and sunglasses that are in good condition are carefully checked and reused. Metal frames and gold and silver scrap are sent to a refinery to be melted. The resulting funds are used to buy new prescription glasses. Lenses without frames cannot be used.

With a vacuum tube, Chester Kanecke, mold cleaner at Plant 2, Firestone Tire & Rubber Company, Akron, Ohio, draws finely ground English walnut shells into a machine used to clean aluminum tire molds. The shells then are blown through the tube into the shield (shown on upper half of mold), where they blast the mold clean. Following this they are drawn out through another tube by vacuum. The walnut shells have replaced sand or other materials that might pit the aluminum.

Address a post card to Science and Technology, 1515 Massachusetts Ave., N.W., Washington 5, D. C., for further information about any item on page iv.

New Books Received

Styrene. Its Polymers, Copolymers and Derivatives. R. H. Boundy and R. F. Boyer, Eds. xxii + 1304 pp. Illus. $20.00. Reinhold, New York. 1952.

Polarography, Vol. II. (2nd ed.) I. M. Kolthoff and James J. Lingane. xvii + 990 pp. Illus. $11.00. Interscience, New York. 1952.

Fatigue and Fracture of Metals. A Symposium. William M. Murray, Ed. viii + 313 pp. Illus. $6.00. Technology Press, Massachusetts Institute of Technology; Wiley, New York. 1952.

Man, the Chemical Machine. Ernest Borek. x + 219 pp. $3.00. Columbia University Press, New York. 1952.

The Psychoanalytic Study of the Child, Vol. VII. Ruth S. Eissler *et al.*, Eds. 448 pp. $7.50. International Universities Press, New York. 1952.

Handbook of Diet Therapy. Prepared for the American Dietetic Association. (Rev. ed.) Dorothea Turner. x + 138 pp. $3.50. University of Chicago Press, Chicago. 1952.

The History of American Epidemiology. C.-E. A. Winslow *et al.* 190 pp. $4.75. Mosby, St. Louis. 1952.

The Mechanisms of Disease. Joseph Stambul. xxxiii + 746 pp. $15.00. Froben Press, New York. 1952.

Synopsis of Pathology. (3rd ed.) W. A. D. Anderson, 788 pp. Illus. $8.00. Mosby, St. Louis. 1952.

The First Hundred Years of the Mount Sinai Hospital of New York, 1852–1952. Joseph Hirsh and Beka Doherty. xv + 364 pp. Illus. $5.00. Random House, New York. 1952.

Modern Nationalities. A Sociological Study. Florian Znaniecki. xvi + 196 pp. $3.95. University of Illinois Press, Urbana. 1952.

Population on the Loose. Elmer Pendell. xix + 398 pp. + 3 cartoons by Jay N. Darling. $3.75. Wilfred Funk, New York. 1951.

Wellsprings of Democracy. Guidance for Local Societies. John M. Brewer. xii + 232 pp. $4.50. Philosophical Library, New York. 1952.

The Birds of Crater Lake National Park. Donald S. Farner. xi + 187 pp. Illus. (No price given.) University of Kansas Press, Lawrence. 1952.

Evolution and Human Destiny. Fred Kohler. 120 pp. $2.75. Philosophical Library, New York. 1952.

Early Man in America. A Study in Prehistory. E. H. Sellards. xvi + 211 pp. Illus. by Hal Story. $4.50. University of Texas Press, Austin. 1952.

Beef Cattle. (4th ed.) Roscoe R. Snapp. xiv + 641 pp. Illus. $6.50. Wiley, New York. 1952.

Journey into Wonder. N. J. Berrill. xiv + 338 pp. Illus. $4.00. Dodd, Mead, New York. 1952.

The Science of Zoology. James C. Perry. xiv + 709 pp. Illus. $6.50. Bruce, Milwaukee. 1952.

Semimicro Laboratory Exercises in General Chemistry. (2nd ed.) J. Austin Burrows *et al.* xviii + 302 pp. Illus. $3.50. Macmillan, New York. 1952.

Semantics and the Philosophy of Language. Leonard Linsky. ix + 289 pp. $3.75. University of Illinois Press, Urbana. 1952.

The Nature of Culture. A. L. Kroeber. x + 438 pp. Illus. $6.50. University of Chicago Press, Chicago. 1952.

Monographs on the Physics and Chemistry of Materials. Vol. 11, *Detonation in Condensed Explosives.* J. Taylor. xi + 196 pp. + 10 plates. $5.00. Oxford University Press, New York. 1952.

Polarography, Vol. I. (Rev. ed.) I. M. Kolthoff and James J. Lingane. xvii + 420 pp. Illus. $9.00. Interscience, New York and London. 1952.

Elementary Statistics. (Rev. ed.) Morris Meyers Blair. xiv + 735 pp. Illus. $5.50. Holt, New York. 1952.

Physical Foundations of Radiology. (2nd ed.) Otto Glasser *et al.* xiii + 581 pp. Illus. $6.50. Paul B. Hoeber, Inc. (Medical Book Department of Harper & Bros.), New York. 1952.

Mathematical Models. H. Martyn Cundy and A. P. Rollett. 240 pp. Illus. $5.50. Oxford University Press, New York. 1952.

Algebraic Technique of Integration. (2nd ed.) Harris F. MacNeish. viii + 133 pp. $2.50. Wm. C. Brown, Dubuque, Iowa. 1952.

Foundations of Algebraic Topology. Samuel Eilenberg and Norman Steenrod. xv + 328 pp. $7.50. Princeton University Press, Princeton, N. J. 1952.

Chemistry of Carbon Compounds, Vol. I, Part B. E. H. Rodd, Ed. xvi + pp. 779–1462. Elsevier, Amsterdam–Houston. 1952.

Recent Progress in Hormone Research. The Proceedings of the Laurentian Hormone Conference, Vol. VII. Gregory Pincus, Ed. 527 pp. Illus. $9.50. Academic Press, New York. 1952.

Advances in Protein Chemistry, Vol. VII. M. L. Anson, Kenneth Bailey, and John T. Edsall, Eds. viii + 411 pp. Illus. $8.50. Academic Press, New York. 1952.

Phosphoric Acid, Phosphates and Phosphatic Fertilizers. (2nd ed.) William H. Waggaman. vii + 683 pp. Illus. $15.00. Reinhold, New York. 1952.

Biography of an Idea. John Bainbridge. 381 pp. Illus. $4.00. Doubleday, New York. 1952.

Beet Sugar Economics. R. H. Cottrell, Ed. xiii + 379 pp. $5.00. Caxton Printers, Caldwell, Idaho. 1952.

Functional Endocrinology. From Birth through Adolescence. Nathan B. Talbot, Edna H. Sobel, Janet W. McArthur, and John D. Crawford. xxx + 638 pp. Illus. $10.00. Pub. by Harvard University Press, Cambridge, Mass., for the Commonwealth Fund. 1952.

Sigmund Freud—An Autobiographical Study. Trans. by James Strachey. 141 pp. $2.50. Norton, New York. 1952.

Lecture Demonstration Experiments for High School Chemistry. Fred T. Weisbruch. 333 pp. Illus. $4.50. Educational Publishers, St. Louis. 1952.

Man and Epidemics. C.-E. A. Winslow. vii + 246 pp. Illus. $4.00. Princeton University Press, Princeton, N. J. 1952.

Problems of Aging. Transactions of the Fourteenth Conference Sept. 7–8, 1951. Nathan W. Shock, Ed. 138 pp. $3.00. Illus. Josiah Macy, Jr. Foundation, New York. 1952.

An Explaining and Pronouncing Dictionary of Scientific and Technical Words. W. E. Flood and Michael West. viii + 397 pp. $2.25. Illus. Longmans, Green, New York. 1952.

Man Into Wolf. Robert Eisler. 286 pp. $6.00. Philosophical Library, New York. 1951.

The Treatment of Injuries to the Nervous System. Donald Munro. xvi + 284 pp. $7.50. Illus. Saunders, Philadelphia and London. 1952.

The Lost Discovery. Frederick J. Pohl. 346 pp. Illus. $3.75. Norton, New York. 1952.

THE
SCIENTIFIC MONTHLY

JANUARY 1953

Some Aspects of Engineering Meteorology

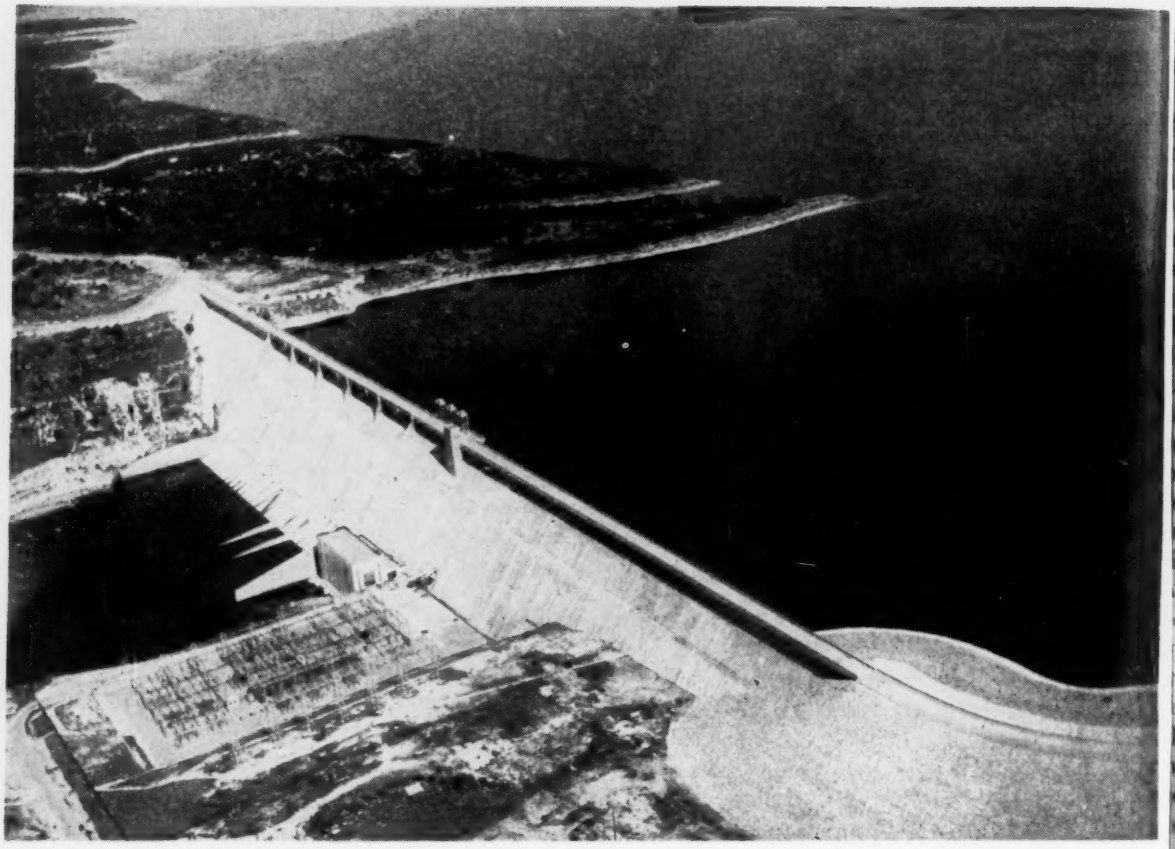
K. H. JEHN*

Kenneth Jehn received his training in meteorology at Rutgers, New York University, and the University of Texas. He was with the Air Force from 1943 to 1946. In the latter year he became meteorologist in the Electrical Engineering Research Laboratory of the University of Texas, Austin. He is now research meteorologist and assistant professor of meteorology.

METEOROLOGY, as the science of atmospheres, logically concerns itself with such analytical studies as the physics, thermodynamics, and fluid dynamics of the atmosphere, as well as with the spatial distributions of meteorological elements which, when integrated over an appreciable time interval, are incorporated into the field of climatology. Beyond what might be termed a study of the physical basis of meteorology, however, is the highly pragmatic consideration of the impact of the atmospheric environment upon living things, including man, and upon the various structures which man has erected upon the face of the earth. It is this very importance of the behavior of the atmospheric environment in the affairs of men which dictates the need for a consideration of meteorological factors in the solution of various engineering problems.

Engineering Meteorology Defined. The term "engineering meteorology" is used in the title of this paper and frequently throughout the text. In view of the rather widespread use of the term "meteorological engineering" in some of the literature cited, some justification for the author's choice will be offered. Engineering meteorology is best defined as the application of meteorological principles and practices to certain engineering problems, just as engineering mathematics is considered to be the application of mathematical principles and practices to certain engineering problems. It is in this sense that the term engineering meteorology is used in this article, and it is plain that many of the authors cited used meteorological engineering in this sense. The term meteorological engineering should be reserved, however, for the application of engineering principles and practices to meteorological problems; more plainly, meteorological engineering is engineering of the atmosphere. In terms of any accepted definition of engineering, this becomes a significant concept, and a practically virgin field of study. A beginning has been made, primarily in the field of applied cloud physics[1] and

* For a critical reading of the manuscript, the author is indebted to J. R. Gerhardt, R. C. Staley, and M. J. Thompson, all of the University of Texas.



Multipurpose dam. Aerial view of giant Mansfield Dam, key flood control structure of the Lower Colorado River Authority's chain of six dams, shows the massive mile-long concrete dam and the 2,000,000 acre-foot reservoir stretching behind it. The hydroelectric power plant is capable of producing 105,000 kw. (Photo courtesy Lower Colorado River Authority.)

in agricultural meteorology, but there are enough problems here to occupy meteorological engineers for centuries to come.

Meteorology Applied to Engineering Fields. During World War II, the application of meteorological knowledge and techniques to military and naval operations achieved a high degree of success. Jacobs[2] treats some of the aspects of climatology applied to war, and indicates the desirability of applying some of the war-developed techniques to civilian needs. These techniques fall into two major categories: the design or planning aspect of meteorology or climatology in engineering problems, and the forecasting aspect. An example will serve to illustrate the differences between them. Suppose that a civil engineer is concerned with the design of a multipurpose hydrologic structure. This design is determined in part by the magnitude of the maximum flood to be expected over the life of the structure. The estimation of this so-called design flood is a hydrological problem and contains meteorological factors that must be taken into account.[3] The best possible use must be made of available precipitation and other climatological data relating to this problem,[4] so that the mathematical probabilities of floods of various magnitudes are made available to the engineer in his calculations. This example represents the systematic use of appropriate climatological factors in solving an engineering design problem. No forecasting is involved, in the usual sense of a particular weather event anticipated at a given time.

On the other hand, the electric company selling power generated later by this or another hydrologic structure may find that a foreknowledge of precipitation makes it possible for a hydroelectric plant to "increase its output, drawing down the pond, and thus conserving an appreciable amount of water that would otherwise be spilled over the dam."[5] If a drawdown operation could be followed by a return to normal pond elevation in a few days, a large saving in coal burned in the steam generating plant could be achieved. In this case, ac-

urate forecasting of weather conditions over a eriod of a few days is required.

Engineers have been required many times in the ast, and will continue to be required, to solve roblems involving the release of industrial wastes o the atmosphere.[6] Fortunately, the atmosphere as practically infinite capacity for the dilution of tmospheric pollution; the engineering problem rises when the rate of dispersion or dilution is inufficient to prevent excessive local concentrations. his fact alone is eloquent testimony of the need or an intelligent appraisal of the meteorological actors, because the diffusion of gaseous or particuate matter in the atmosphere is controlled in large easure by meteorological conditions. The meteorological problem again has two aspects: the orecasting aspect embodied in meteorological conrol, and the planning aspect involved in the selecion of a site for a plant for which there is a difficult aste disposal problem. (The term "meteorological ontrol" is used here in the limited sense of an perational control dependent upon meteorological actors either present or forecast. In a broader ense, meteorological control may be considered he practical equivalent of meteorological engiceering. Meteorological control in this broader ense, with particular reference to cloud physics, as been discussed by Langmuir.[7])

With regard to meteorological control in the imited sense, then, which may involve complete or partial shutdown of offending plant operations when atmospheric conditions do not favor rapid dispersion,[8] the problem must be solved on the basis of the particular industry involved. Meteorological control may be used at a smelter, but it is impractical in the case of a steam power plant.[9] Here it might be necessary to remove offending materials before combustion, or to apply washing or precipitation techniques to the flue gases. It is hardly necessary to point out that the relationship of the meteorological factors to the particular operation must be known in order for these techniques to be effective. Moreover, accurate short-range forecasting will increase the effectiveness, permitting better planning of plant operation. The forecasting approach in meteorological control is being used by the meteorology group at the Brookhaven National Laboratory,[10] where an atomic pile has recently been put into operation.

No engineering reference to atmospheric pollution would be complete without a mention of particular cases in which the slowness of atmospheric diffusion of gaseous wastes so built up ground concentrations as to bring disaster to the community near the industrial plant. Such was the case in the Meuse Valley in Belgium in 1930 and in the more recent Donora, Pennsylvania, disaster.[11]

Rigging KYTOON for measurement of vertical temperature gradient. Recorder in jeep. These data are used to solve site problems, such as setting heating or refrigeration loads. (Photo courtesy E. I. du Pont de Nemours & Co.)

The oil industry, particularly in Gulf Coast locations on land or water, has discovered from experience that the weather enters into its operations in no uncertain terms.[12] One of the most complete treatments of engineering meteorology with particular reference to the oil industry in its Gulf operations is presented by Bates and Glenn,[13] consulting meteorologists, with headquarters in New Orleans and Washington, D. C. These men have profited from their wartime experiences in meteorology, hydrology, and oceanography to the extent of developing a successful meteorological consulting service in the Gulf areas. Particular problems involved here may include practicable conditions for surface or aerial transportation in geophysical exploration; wave and swell conditions during marine construction and drilling; choice of best working months for different types of operations; and the location and

Radar antenna at Grand Isle, Louisiana, used in detecting and tracking storms in the Gulf of Mexico near oil drilling platforms. (A. H. Glenn & Associates photograph.)

utilization of various installations influenced by such factors as surface temperature, precipitation, humidity, and surface winds.

These examples indicate some of the types of difficulties which the engineering meteorologist is likely to encounter. Among other problems is the providing of general weather information about locations being considered for new plant sites. The planning groups may need to be provided with sufficient data so that the potential cost difference between sites can be evaluated from the weather viewpoint. In the design of the components of an industrial plant, precise weather data must be supplied "so that the best estimates may be of the efficiency of different kinds of equipment, as well as the first and operating costs of that equipment."[14] Examples of the type of equipment affected by the weather are such things as the atmospheric cooling tower, heating and air conditioning equipment, and cooling ponds.

Plant location and design need not be industrial to be affected by the weather, of course, and the architect and architectural engineer can use the meteorologist's special skills to advantage. A consideration of architectural problems from the weather point of view introduces the concept of local climate, or microclimate. Significant variations of the microclimate occur over relatively short horizontal and vertical distances.[15] It is to the advantage of the architect and the people he serves to take the microclimate into account; an appropriately trained meteorologist is the specialist who can best assist in this problem. It is worthy of note that the editors of *House Beautiful* have made a significant contribution to a better understanding of this field in their series on climate control.[16]

The civil engineer may be concerned with the design and location of structures other than hydrologic ones. Highways, for example, pose engineering problems which depend for their effective solution on a knowledge of the state of the atmosphere.[17]

The electrical engineer may be concerned with the effects of severe weather upon power transmission; some power companies have worked out detailed studies of weather factors in their operations, with the result that load dispatching is more efficiently carried out.[18]

One of several waterspouts observed from a crewboat tied alongside an offshore drilling platform approximately six miles south of Grand Isle, Louisiana. The waterspout was associated with convective activity set off by a slow-moving cold front south of Grand Isle. (Photo by Mel Coston, Humble Oil and Refining Co.)

Some Research Aspects of Engineering Meteorology. The meteorologist also enters the engineering field in a more fundamental way. In the sense that the meteorologist attempts to discover the physical basis of atmospheric phenomena, he becomes a valuable member of the community of scientists engaged in research in various engineering (and other) fields. It is possible, therefore, to consider another aspect of engineering meteorology in which the engineer and the meteorologist work together. Again a few examples will serve to establish the nature of this relationship.

Practicing engineers concerned with air pollution are familiar with the semi-empirical equation of Bosanquet and Pearson,[19] which relates the various parameters in atmospheric diffusion. The British meteorologist O. G. Sutton[20] has developed a theoretical approach to the atmospheric diffusion problem based on G. I. Taylor's statistical theory of turbulence. Chemical engineers, using field data (concentrations of SO_2) from smelters in several locations in the United States, have found that the data from tall stacks agree well with the theoretical equations.[21]

The design of an aircraft must of necessity be governed in part by the characteristics of the atmosphere through which the plane must eventually fly. The mean state of the atmosphere, represented, for example, by the NACA tables, is insufficient to specify the stresses a plane may undergo in the turbulent inner portions of a cumulus cloud, or even in landing or taking off in the rough air in the lowest few hundred feet of the atmosphere. The meteorologist and aeronautical engineer, therefore, have a common interest in the atmosphere, and particularly in the turbulent currents which occur in varying degrees of intensity and scale. As a consequence, a considerable aerodynamic literature has been developed, with contributions from both aeronautical engineers[22] and meteorologists.[23]

In the field of communication engineering, the effects of meteorological factors on transmission of short radio waves through the atmosphere are being studied intensively, and a considerable literature on radio meteorology has also been built up. The Electrical Engineering Research Laboratory of the University of Texas has pioneered in this work, and any one of several references[24] will serve as an introduction to the meteorology of radio engineering.

It is seen that a distinction can be made between what might be termed practical engineering meteorology and the research aspects. This distinction is in many respects similar to the distinction between applied and pure research; neither can advance significantly without the other.[25] It was to delimit this paper that primary emphasis has been placed upon practical engineering meteorology.

Equipment used in measuring short-wave radio propagation in the lower atmosphere on a 30-mile overwater path near Galveston. (Photo courtesy Electrical Engineering Research Laboratory, University of Texas.)

Features Common to Engineering Fields. Throughout these examples of engineering meteorology, certain features stand out. First, it is evident that many engineering problems contain certain weather factors, probability forecasts for which are needed in the solution of the problems. "Equipped with such knowledge [the engineer] can design to avoid failure without resort to blind extravagance; engage in sharp competitive bidding without jeopardizing his financial position; take advantage of Nature when she is kind, and protect himself against her when she engages in excesses."[26] Second, there are distinct differences between the design and forecasting phases of engineering meteorology; both the meteorologist and the engineer must recognize these differences in order most effectively to utilize meteorological and climatological data. It is plain that later accurate forecasting cannot make up for poor original design. Third, engineering meteorology is largely of a consulting

Views of hurricane damage at Freeport, Texas, following storm of October 3–4, 1949. (Photos courtesy The Dow Chemical Company.)

nature. This implies private meteorological consultants, selling their services to various industries and businesses, but certainly does not preclude staff consultants on the pay roll of an industrial firm. "The usefulness of the weather engineer is judged by his ability to provide the company with the means for more efficient operation . . . by utilizing a consulting technique to give advice to various divisions of the concern, for example, management, design, operating sales, or planning sections."[27] Fourth, the effective engineering meteorologist must acquire technical knowledge concerning the industrial or business operations with which he is working. The implication here is that more efficient use of the meteorologist's services can be made if he has a staff rather than a private consultant's position. Obvious exceptions exist, of course, and it becomes necessary for the company to decide whether to hire a full-time meteorologist or to pay a consultant for particular services.

Training for Engineering Meteorology. For details of the recent (1949) status of applied meteorology in the United States, reference is made to Bates.[28] By and large, it appears that consulting and staff meteorologists are making significant

contributions to the solution of engineering and business problems. The development has been slow, in spite of the farsighted view of the situation offered by Rossby in 1945.[29] One of the important reasons for this slow development is the general lack of training in engineering meteorology. According to Bates, this problem might be remedied if engineering schools with meteorology in the curriculum would specialize in engineering meteorology. To the best of the author's knowledge, there is no such school at the present time. Jacobs first noted this lack in 1947.[30]

A realistic approach must involve a capable practicing engineering or industrial meteorologist, who would be invited to give a series of lectures or a full course of study as a visiting professor on the faculty of an engineering college. Such a course should be on the advanced undergraduate and graduate level, and would serve to pass certain fundamentals and practical knowledge on to meteorology students and faculty. Because of the diversified problems found in engineering fields, several lecture series would need to be arranged over a period of years. On the whole, the meteorological faculties at the various engineering colleges are potentially equipped to undertake such training, but need the infusion of experience which could come in part from the visiting lecturer and in part from the professional practice of engineering meteorology during leaves of absence from teaching. From a small beginning, and with adequate opportunities for students and staff to practice engineering meteorology on even a small scale, it is conceivable that a suitable course of study would eventually be evolved, and that eminently qualified graduates would enter the field.

It is the opinion of this writer that the approach used by the Illinois Institute of Technology[31] is not the answer to the problem of training in engineering meteorology. Obviously, to acquaint engineering students with meteorology as it affects engineering practice is a desirable thing; however, the primary need is for professional meteorologists, trained in basic engineering fields, who will extend and enlarge the scope of engineering meteorology through professional practice.

Engineering meteorology is still in swaddling clothes; perhaps it is not vain to hope that it will soon enter the "vigorous stage of advancement" now enjoyed by the field of industrial hygiene. According to Patty,[32] "Industrial hygiene is no longer seen by industry as the aimless effort of intellectuals collecting bottles filled with nothing so that they can prepare long and useless discourses that few read or understand, or, if they did understand, would know what action to take." In the sense that

Masonry dwelling utilizes a roof sprinkling system as a summer cooling device. (Acme Ceramic Home Program, Austin, Texas.)

meteorology and medicine enjoy similar problems of diagnosis and prognosis in the face of sometimes great uncertainty, so industrial hygiene has passed and industrial meteorology is passing through a stage of development which involves proving its worth to industry and the engineering fraternity.

References

1. Langmuir, I. *J. Meteorol.*, **5**, 175 (1948).
2. Jacobs, W. C. *Meteorol. Monographs*, **1**, 1 (1947).
3. McClendon, E. W. *Bull Am. Meteorol. Soc.*, **31**, 238 (1950).
4. Bernard, M., *et al. Hydrology Handbook*. New York: American Society of Civil Engineers (1949).
5. Dryar, H. A. *Bull. Am. Meteorol. Soc.*, **30**, 159 (1949).
6. Swain, R. E. *Ind. Eng. Chem.*, **41**, 2384 (1949).
7. Langmuir, I. *Science*, **112**, 35 (1950).
8. Hewson, E. W. *Ind. Eng. Chem.*, **36**, 195 (1944).
9. Stern, A. C. *Heating and Ventilating*, **42**, 64 (Jan. 1945); 73 (Feb. 1945).
10. Smith, M. E. Atomic Energy Commn. pub. AECU-702 (1950).
11. Brandt, A. D. *Heating, Piping, Air Conditioning*, **21**, 97 (1949); Schrenk, H. H., *et al. Public Health Bull. No. 306*. (The need for an authoritative and complete annotated bibliography of the air pollution literature has been met through publication by the Am. Meteorol. Soc. of H. P. Kramer and M. Rigby's Cumulative Annotated Bibliography on Atmospheric Pollution by Smoke and Gases, in *Meteorol. Abstr. and Bibliog.*, **1**, 46 [Jan. 1950]).
12. Fagin, K. M. *Petroleum Engr.*, **19**, 82 (1948); **21**, B65 (1949).
13. Bates, C. C., and Glenn, A. H. *Oil Weekly*, **125**, 33 (May 19, 1947); 42 (May 26, 1947).
14. Gosline, C. A. *Bull. Am. Meteorol. Soc.*, **30**, 119 (1949).
15. Landsberg, H. E. *Weatherwise*, **3**, 7 (1950); Baum, W. A. *Ibid.*, **2**, 75 (1949).
16. Siple, P., *et al. House Beautiful*, **91**, 136 (1949). (This is a continuing project, and articles on the general subject of climate control have appeared in succeeding issues, the latest in July 1952.)
17. Landsberg, H. E. *Better Roads*, **17**, 25 (1947).
18. Dryar, H. A. *Op. cit.*
19. Bosanquet, C. H., and Pearson, J. L. *Trans. Faraday Soc.*, **32**, 1249 (1936); Bosanquet, C. H. *J. Inst. Fuel*, **8**, 119 (1935).
20. Sutton, O. G. *Quart. J. Roy. Meteorol. Soc.*, 73, 426 (1947).
21. Thomas, M. D., *et al. Ind. Eng. Chem.*, **41**, 2409 (1949).
22. Dryden, H. L. *Quart. Appl. Math.*, **1**, 7 (April 1943).
23. Taylor, G. I. *Proc. Roy. Soc.* (London), **A** 151, 421 (1935).
24. Appleton, E., *et al.* Meteorological Factors in Radiowave Propagation (Report of a conference held in London in 1946 by the Physical Soc. and The Roy. Meteorol. Soc.), London: The Physical Soc.; Booker, H. G., and Gordon, W. E. *Proc. I. R. E.*, **38**, 401 (1950); Kerr, D. E., Ed. *Propagation of Short Radio Waves* (1950).
25. Morse, P. M. *Am. Scientist*, **38**, 253 (1950).
26. Bernard, M. *Bull. Am. Meteorol. Soc.*, **31**, 194 (1950).
27. Gosline, C. A. *Op. cit.*
28. Bates, C. C. *Bull. Am. Meteorol. Soc.*, **30**, 199 (1949).
29. Rossby, C.-G. An Appraisal of the Present Status of Meteorology and its Ability to Serve Industry. Mimeographed notes (1945).
30. Jacobs, W. C. *Op. cit.*
31. Malkus, J. S. *Bull. Am. Meteorol. Soc.*, **30**, 310 (1949).
32. Patty, F. A., Ed. *Industrial Hygiene and Toxicology*, Vol. 1. New York: Interscience, 15 (1948).

INFINITUDE

Beyond my heart there is another heart,
Beyond these hearts, the world, and then an age,
And ages in themselves are infinite.
Beyond this world there is another world,
A hundred million solar systems that combine
To form a single galaxy, indefinite.
From galaxy to galaxy the universe
Expands, and ages that have been and yet will be—
What meaning have they for this shackled mind,
This microcosm of Intelligence,
That seeks, but ever binds the heart of me?

Rhoda Walton Leonard

Los Angeles, California

The Visa Problem

SIDNEY PAINTER, H. A. MEYERHOFF, and
ALAN T. WATERMAN

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ON OCTOBER 27, by formal request, spokesmen for the American Council of Learned Societies, the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, and the National Science Foundation submitted prepared statements before the President's Commission on Immigration and Naturalization. Although the commission is primarily concerned with problems affecting immigration, the three organizations were specifically asked to investigate the effect of the *McCarran Act* of 1950 on visits of foreign scholars to this country.

Representatives of the council, the foundation, and the AAAS conferred prior to the hearing to assure adequate coverage of the subject without serious duplication, and it was quickly discovered that each organization felt it had a specific and clearly defined function to perform, as the ensuing statements will demonstrate. The American Council of Learned Societies, with the cooperation of the American Council on Education, was especially concerned with exchange of scholars in all fields of learning. The AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE dealt with the problem as it relates to scientists, supporting its stand with cases supplied through the cooperation of the American Chemical Society, the American Institute of Biological Sciences, the American Institute of Physics, the American Psychological Association, the Federation of American Societies for Experimental Biology, the mathematical societies, the National Research Council, and the editorial staff of the *Bulletin of the Atomic Scientists.* The foundation gathered its background material chiefly from government agencies interested in, and concerned with, scientific research. Without minimizing the importance of measures designed to safeguard national security, the three organizations made a strong case for drastic liberalization of the *McCarran Act* of 1950 and, by implication, the *McCarran-Walter Act* of 1952, as well as of the administration of these acts by the departments of State and Justice.

The ACLS Statement

The American Council on Education has indicated its interest in the passport and visa problems affecting scholars in the humanities and the social sciences by consulting with the American Council of Learned Societies about this statement and has had occasion in the past few years to deal with various government agencies concerned with this problem.

Both these organizations and their constituent societies are vitally interested in anything that affects the international interchange of scholarly publications and personnel insofar as it concerns the development of their respective fields of scholarship. In every field of scholarship in the humanities and social sciences the advancement of knowledge and the promotion of research activities are dependent upon contributions made in many countries. For example, in the field of Biblical studies we depend heavily on the scholars in the University of Jersualem who are close to the source of new materials. Besides this routine day-to-day interest in the effective functioning of international interchange, the ACLS and its constituent societies support the general policy of international intellectual cooperation which they share with other groups of our citizens in the development of a peaceful and friendly free world. This policy has now received legislative formulation as a national policy of our government by several acts of Congress.

In passing the *Fulbright Act* the Congress of the United States clearly expressed its belief that the exchange of scholars between this country and others served the interests of the United States. Congress has confirmed its acceptance of this point of view by generous appropriations to carry out the Fulbright program, both by setting up agencies to administer it and by supplying supplementary funds.

Moreover, Congress in the *Educational Exchange Act* of January 27, 1948, made provision for interchange between the United States and other

countries of students, professors, and leaders in fields of specialized knowledge or skill. In that act Congress also provided for the establishment of the United States Advisory Commission on Educational Exchange to be appointed by the President, with the advice and consent of the Senate. This commission consists of five members, not more than three of whom may be of the same political party. Distinguished educators, including Harold W. Dodds, president of Princeton University, have served on that commission. Thus Congress has made clear that it regards the international exchange of scholars as a valuable contribution to the public interest.

This policy established by Congress has received strong support from all those who are interested in the advance of scholarship and the promotion of intellectual cooperation both here and abroad. The various foundations and institutions of higher education have brought foreign scholars to America and facilitated foreign travel and study for the scholars of the United States. The personnel of foundations and universities have devoted a large amount of time and energy to administering this international exchange of scholars. In short, it seems clear that the exchange of scholars is an important part of the policy of the United States, and large amounts of both public and private funds have been devoted to it. Anything that interferes with the effectiveness of this exchange should be a cause of grave concern to the country.

The American Council of Learned Societies is one of the organizations that have taken an active part in encouraging the international exchange of scholars. The learned societies that compose it have a vital interest in the exchange of ideas and knowledge between the scholars of the United States and those of other lands. They also value the effect of this exchange on international amity and understanding. The directors of the council have for some time been disturbed by reports that the policy of the United States in issuing visas and the administration of this policy have done much to nullify the effectiveness of the program. In its spring meeting the Board of Directors appointed a committee to investigate this situation and to recommend action if it seemed desirable and feasible.

The directors of the council are not as yet in a position to present statistics or to attempt to assess causes, but there is ample evidence of the seriousness of the situation. Foreign scholars invited to come to the United States are subjected to extensive and humiliating inquisitions and incredibly formidable questionnaires. This alone does much to prejudice them against the United States. But far more serious are the delays involved before the visa is received. In many cases the visa has come so late that the opportunity to visit the United States no longer exists.

These annoyances and long delays both hamper the arrangement of exchanges and create bad feeling which affects far more than the individual scholar concerned. Reports of these annoyances and delays spread rapidly, and the reputation of the United States is gravely injured. In England, at least, there is a serious question whether the damage done by reports of the humiliations inflicted on scholars planning to visit the United States has not overbalanced the good effects of the exchanges made.

The council is fully aware of the difficulties involved in enforcing the immigration acts passed by Congress. It has only one suggestion to make. Scholars are as a rule well known to their colleagues, and their opinions and activities are rarely secret. Most of them are attached to institutions of learning. Might not a statement from a university or research institution be accepted prima facie as adequate evidence of a scholar's suitability for admission to this country on a nonimmigrant basis?

Moreover, in view of the fact that visiting scholars are not numerous in comparison with the traveling public generally, and are usually coming to the United States to attend a particular conference or school term, with fixed and definite dates, it seems that possibly an expedited procedure for handling these cases could be established, if the consular authorities were appropriately instructed by the Department of State regarding the importance of promoting the congressional policy regarding educational exchange. They should also be informed of the possible detrimental effects to international goodwill which might be produced by failure to handle these applications promptly. On account of the status of the parties concerned, these consequences in such cases would be out of proportion to the number of persons affected.

The AAAS Statement

It is my understanding that the members of the commission are especially interested in securing testimony relative to the visa problem, which affects foreign scientists who wish to visit this country on scientific missions, rather than to immigrate with the intention of becoming American citizens. The information on immigration as it relates to foreign scientists is meager and difficult to assemble, and no effort will be made to cover this aspect of

the subject which, however, I believe has been dealt with by other witnesses. It should be noted that the implications of visitation are so drastically different from those of immigration that the two merit not only separate consideration but distinctive procedural handling.

The AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE and its affiliates have been interested in assuring relative freedom of movement for scientists and other professional people from one country to another, subject to necessary but reasonable security regulations, ever since the termination of the war in 1945. The Association's interest is based on the experience that science is international, discoveries in basic science may occur in any country, and the only way in which our nation can remain in the forefront of scientific and technological development is through unhampered intercommunication. The problems relative to international travel, except in the countries behind the Iron Curtain, did not become well defined until the passage of the legislation now in force. Up to the present time there has been no official consideration or action with reference to the implications of the new legislation.

The Association has taken official cognizance of problems encountered in administering existing legislation through its Council, which passed a resolution at Philadelphia on December 29, 1951. The AAAS Council is the policy-making body of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, comprising approximately 250 members, some of whom represent the 48,000 individual members of the AAAS, but most of whom are official representatives appointed by the 184 affiliated societies, which are entitled to one or two representatives, depending upon the size of their respective memberships.

The resolution that was adopted at the Philadelphia meeting of the Council was, naturally, concerned with the two-way movement of scientists; hence it deals with both passports and visas. Inasmuch as it sets forth a widespread, though by no means unanimous, reaction of scientists to certain provisions of the law and to its administration, it has pertinence in this testimony, and I quote it herewith:

> The Council of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE is profoundly disturbed over the present world conditions which so severely impede the free interchange of knowledge even among friendly nations. Danger to the future of our nation is implicit in such restrictions.
>
> The Council recognizes the need for measures which will effectively safeguard our security, but expresses its troubled concern over the manner in which such measures, in particular the *McCarran Act*, are being administered, to prohibit American citizens from going abroad and citizens of other nations from coming here to interchange knowledge of science which does not affect security.
>
> The Council strongly urges that the administrative procedures under the *McCarran Act* be reviewed and modified so as to minimize injustices and to increase both our internal strength and our prestige abroad.
>
> The Council further urges revision and improvement of the relevant portions of the act, to retain the objectives of necessary security, but with adequate provisions to maintain free interchange of knowledge that has no security implications.

The phraseology of the resolution indicates quite clearly that American scientists have, from time to time, encountered difficulty in securing passports for travel abroad and that foreign scientists have likewise encountered comparable difficulties in carrying out plans to visit this country. There has, of course, been no opportunity for additional experiences under the new legislation, but there is no reason to believe that the situation will change in any essential way. Inevitably the operation of any law becomes evident in its application to individual cases, and the only effective way to deal critically with a law is through the discussion of specific cases.

This type of procedure is fraught with dangers insofar as the cases presented may or may not possess validity. It will be readily appreciated by the commission that scientists and scientific organizations are not in a position to investigate, or to test the validity of, individual cases; yet it is important to recognize that the invalidity of any individual case does not in any way weaken criticism that would have applied had the case possessed validity. Fortunately, the experiences of many foreign scientists have been quite carefully documented, and twenty-six of them have been presented in the October 1952 issue of the *Bulletin of the Atomic Scientists*. I wish to enter this issue of the periodical in question officially into the record that will be studied by the commission. Despite the documentation, I wish to make no specific claim for the validity of any of the cases presented in detail, although I might state that the statement prepared by Michael Polanyi seems to merit careful study and analysis.

I am prepared to add to the twenty-six cases presented in this special issue of the *Bulletin of the Atomic Scientists*, if the commission so desires. The material that has been placed in my hands or that has come directly to the Association from individuals involved in visa problems provides information on eight additional cases, as well as supplementary documentation for some of the cases presented in the *Bulletin*. It seems of greater

importance, however, in this brief statement to extend the testimony in a different direction, and also to make some effort to classify and to systematize it.

Of very serious concern to the scientists of this country is the fact that, within the past twelve months, scientists in at least five different fields have definitely decided against holding international meetings in the United States. The most candid reaction has come from the psychologists, and a statement from the American Psychological Association dealing with this matter has been read into the *Congressional Record* (**98,** [88], 5920 [1952]). Here it was stated that, in deciding to hold the 1954 International Congress of Psychology in Canada, the psychologists agreed not to hold a meeting in the United States until and unless the existing legislation is "modified in such a way that visiting scientists will not be put through an inconvenient and embarrassing procedure in order to gain permission to visit this country."

Comparable action was taken by the International Congress of Genetics in voting to hold the ninth congress in Italy in 1953, and the tenth congress probably in Canada in preference to the United States. Although the astronomers of the International Astronomical Union were somewhat more reticent in official records regarding the locale of their next meeting, it is understood they declined an invitation to meet in the United States for the same reason. The 1954 International Federation of Documentation and the nineteenth International Physiological Congress will also meet outside the United States, notwithstanding invitations to meet here, but other reasons were given for the decisions in both these cases—specifically, the unfavorable rate of foreign exchange.

With respect to the individual scientists who have been denied entry or who have been delayed in entering the United States, analysis reveals that they can be classified into a comparatively small number of types.

1. In regard to foreigners who are active members of the Communist Party, the *McCarran Act* of 1950 is specific, and no particular issue has arisen, although the need to deal as rigorously with visitors as with immigrants has been questioned.

2. Foreign scientists who at any time past had admitted or alleged connections with the Communist Party have been given the same treatment as active Communists, yet their cases have possessed varying degrees of merit, to which adequate consideration has rarely been given. Enforced membership in the Communist Party without Communist sympathy, or temporary membership in the party for the purpose of combating Nazi occupation through "underground" activity, and voluntary membership that was ultimately renounced when full comprehension of the implications of Communism was acquired are three types of background cases encountered in this general category. Analogous situations have been faced in dealing with German citizens who had been forced into nominal membership in the Nazi Party in Germany. The new *McCarran-Walter Act* of 1952 sets up machinery for appeals by individuals in this category, but decisions are still discretionary and hence problematic.

3. Categories 1 and 2 are created by specific provisions of the act, but a much larger group of prospective scientific visitors is affected by the administration of the act. Foreign scientists whose political records are above reproach and whom the act was clearly designed not to exclude commonly find themselves involved in the operation of machinery that has not been satisfactorily geared to the volume or the kind of business that must be processed. A few sensitive individuals have resented some of the questions that are asked in conformance with the requirements of the law. Many scientists have experienced such long delays in action on their applications for visas that the events in which they had planned to participate in this country were things of the past before permission to enter the United States was granted. A disconcertingly large number of scientists who were planning longer stays—in some instances as visiting professors in educational institutions—have been delayed or even precluded from entry by consular insistence on additional evidence regarding the adequacy of financial support. Only rarely have the personnel in U. S. consular offices been aware of the dignity and esteem attached to scholastic distinction abroad, and the treatment that has been accorded several foreign scientists by our consular agents has generated, and is generating, an atmosphere of international ill will that has prompted scientists in some of the Western democracies to bracket the United States with the USSR in respect to attitude toward foreign visitors. Inaccurate and unjust as such a comparison may be, its causal relation to the visa problem is ample evidence of defects in the existing machinery of administration that demand correction.

The visa situation should be viewed, and reviewed, against a background in which national security is a dominant factor. As the Association's resolution of December 29, 1951, clearly demonstrates, the scientific profession does not minimize the need to protect our democracy against subversive influences and to guard our scientific and technological secrets. Scientists, however, are only too acutely aware of the fact that there is no protection against the independent discovery of supposed secrets; that scientific progress has international roots, that draw upon basic discoveries made in many different countries for sustenance; that free intercommunication, which will give American scientists quick access to new scientific developments in other countries, is not only vital to the national welfare but crucial in preserving our national security. Scientists heartily endorse the kind of caution that excludes the subversive who seeks to obtain and to export our technological secrets and to import propaganda that aims at the overthrow of our democracy, but they consider any

barrier to the free flow of information into this country as an even greater threat to national security. There is such a threat—inadvertent, to be sure—in certain of the provisions of the present law and in its administration, and it is only this threat that the profession seeks to remove. The importance of the international exchange of scientific information has been partially set forth in an article under that title, prepared by Wallace R. Brode, associate director of the National Bureau of Standards, and published in Vol. 28, No. 50, of *Chemical and Engineering News* (pp. 4332–38) on December 11, 1950, and a reprint of this article is herewith submitted for entry into the record. Although certain of the problems outlined by Dr. Brode have been accentuated during the twenty-two months that have elapsed since the article was printed, his remarks still provide essential background material in dealing with the movement of foreign scientists into this country and of American scientists into foreign countries.

In the preceding remarks, the impression may have been given that the mesh that screens foreign scientists seeking to enter the United States is too fine, and in general this is true. American scientists, especially those working in government laboratories, where highly classified research is being carried on, have, however, been perplexed by statements from the Department of State to the effect that the possession of a visa on the part of a foreign scientist is no guarantee that he is a good security risk, and that possession of the visa does not entitle him to visit laboratories in which classified research is in progress. We are thus confronted with the fact that the task of screening scientific visitors is being carried on so imperfectly that many who are entitled to enter this country are excluded, whereas others, who are admittedly poor security risks, obtain entry. It is understandable that the Department of State should be unwilling to assume responsibility for permitting foreign visitors to have access to classified information and operations; but this very fact indicates that screening cannot be done in the consular offices and should not be attempted, and that more uniform and somewhat more liberal policies should be adopted in giving visas to scientists who are planning comparatively short stays in the United States. The task of screening these visitors for possible access to classified projects and information can more effectively be conducted in this country by agencies that are staffed and equipped for such investigation as may be appropriate.

This rather brief and incomplete summary indicates that the existing legislation—and presumably impending legislation—should be further reviewed and should be revised on the basis of experience that has been acquired since 1950, which was not available when the legislation was drafted and passed by the Congress. From the cases that have been studied and classified it may be concluded that:

1. The provisions of the current law have been responsible for several grave injustices to individuals, whose exclusion from the United States must be viewed as a loss to American science, as well as a setback to American prestige and international good will.

2. The administration of the existing legislation is unsatisfactory, in part because;

a) the facilities for handling the volume of business are inadequate;

b) the personnel upon whom the primary responsibility of administration has fallen only exceptionally have the background and training to handle it judiciously;

c) insofar as current legislation requires investigative procedures, this responsibility cannot be assumed or handled expeditiously by those to whom it has been delegated;

3. Although the new legislation provides machinery for appeals from adverse and presumably unfair decisions in certain cases, it does not solve the major problems or remove the causes for growing international friction and ill will;

4. Without relaxing vigilance against the infiltration of Communists, the law may appropriately and profitably be liberalized and some of the problems solved by distinguishing between those who propose to immigrate into this country and whose qualifications for American citizenship should be critically scrutinized, and those who merely plan short visits and whose scientific knowledge is potentially of value to American institutions and scientific organizations.

I have no wish to leave with the commission the impression that scientists have a distorted perspective on the visa question. The colleagues who have supplied me with information have mentioned as many cases in which foreign scientists have entered this country without trouble or delay, as they have cases where unwarrantd difficulty or outright refusal was experienced. They are rightly concerned, however, with the imperfections of the law and its administration, because these imperfections are creating ill will that is being reflected in the increasing number of decisions on the part of international scientific bodies not to schedule meetings in the United States. If this trend continues, American science faces the threat not merely of becoming provincial but also of becoming atrophied to the point where the national welfare and national security will suffer. Security and welfare are founded on knowledge, only part of which originates within the confines of the United States.

THE NSF STATEMENT

The invitation to the foundation was to testify concerning the impact of the immigration laws

upon science. For the most part the effect of the immigration laws upon science is not substantially different from the effect upon other professional and scholarly activities. In matters concerning the admission of foreign scientists as visitors, however, experience has demonstrated the existence of a problem of special concern to science and one in which the stake of the country is large. It is, therefore, to this special problem that I shall confine my attention.

I should like to place my remarks in perspective by indicating the nature of the interest and the competence of the National Science Foundation in this field. The creation of the National Science Foundation by Congress in 1950 was itself recognition of a fact to which the national and international events in the first half of this century bear witness: the emergence of science and technology as a crucial and sometimes decisive factor in the rise and fall of nations and the personal destinies of all men. The nations of the free world are now engaged in a grim and seemingly endless struggle to maintain the precarious balance for peace and security. In this struggle, the decisive edge in military strength or, if our hopes are realized, in the peaceful development of the economic resources of our world, is likely to go to that nation or group of nations which most successfully supports and develops its scientific and technological strength.

Since the late 1930s, when the magnitude of this country's stake in vigorous scientific research and development began to be apparent, the resources of the government have been marshaled in support of science. Today the federal government's annual budget for scientific research and development is of the order of 2 billion dollars, to which private enterprise and the universities add perhaps 50 per cent more. Nine federal agencies, in addition to the foundation, pursue major research programs covering widely the scientific fields known to man. The National Science Foundation, however, was devised in the years following the end of World War II, "as a much-needed keystone in the structure of the national research program"—to use the words of the President in transmitting the foundation's first annual report to the Congress. One of its principal tasks is to appraise the rapid growth of research activity, both public and private, and to recommend the broad goals toward which this effort should be channeled. The foundation is also directed by the *National Science Foundation Act* to cooperate in international research activities. It is principally in these capacities, then, as the adviser to the government on national policy with respect to scientific research, and as a major agency concerned with international cooperation in scientific research, that the foundation has approached the problem of foreign scientific visitors under the immigration laws.

In assessing the problem of the federal government, the foundation has drawn upon the experience of other government agencies and, through the wide contacts of the foundation with the scientific community in this country, upon the experience of scientists themselves. Upon the basis of information available to the foundation through these channels, it is clear that the provisions of the present immigration laws governing the temporary admission of aliens to this country, and the administration of these laws, have created a problem. If the solution to this problem is long delayed, a seriously detrimental effect on the strength of science in this country may be expected. Any such handicap to our progress in science will in turn unquestionably react adversely on our welfare and security in the years ahead. A further consequence would be a weakening of cooperative relationships with friendly countries in an important component of our common defense—namely, scientific research and development.

The problem arises in the restrictions on temporary admission of an alien visitor, now stated in Section 137 of the 1950 law and retained in the *McCarran-Walter Act*. Since these restrictions have been in effect since 1950, we have had an opportunity to observe their consequences for science. Opinion among scientists is practically unanimous that they have brought about deterioration in the relationships of American scientists with their opposite numbers in countries friendly to the United States, particularly in the United Kingdom and Western Europe.

Effective scientific research calls for creative ability of an outstanding order. Such ability is no respecter of national boundaries. At a given time in a given field of science the leaders in the field are usually found in at least several countries in the world, and the researchers in the field in practically all. Much of the progress in science is achieved through the inspiration and guidance of the few individuals of outstanding competence and experience. For progress on the frontiers of science it is especially necessary that these leaders have opportunities to discuss their ideas and plans with each other and with the large group of research workers who are providing the body of research which comprises that field of science. Observations and conclusions reached by competent scientists in any one country are invaluable to the research of scientists in other countries working on the same or similar

problems. Although I am speaking here primarily of basic fundamental research—i.e., research on a frontier of science—the importance of this exchange of information is no less for our applied research and technology. There is overwhelming evidence on this score. Until well into the twentieth century this country advanced its technology and standard of living to the highest level the world has seen. Yet it is universally admitted that in so doing we drew heavily on the findings and accomplishments in pure science abroad. Without ready access to this foreign stockpile of scientific information, this progress would have been impossible.

Now that we are among those in the forefront of progress in basic scientific research, it is common sense and in the interest of economy to insure that loss of critical time and needless duplication do not arise through failure of ready communication. Without opportunity for exchange of views and information, delay and unnecessary duplication will inevitably occur. It is for this reason that from the very beginnings of science scientists have put a very high value on good channels of communication. The value of direct communication in speed, in dollars, and in ultimate accomplishment is great.

The bulk of international scientific communication is carried out continuously through written media. It is common knowledge, however, that there are limitations on the capacity of the written word to convey complete information that can be useful to cooperative effort or to the work of an individual which requires an intimate knowledge of the work of others. It is hard to imagine this commission or a legislative body attempting to draft legislation by correspondence, or a court reaching a just and impartial decision without having seen or heard the opposing witnesses in person. As in all human affairs, there is no substitute for informal discussion face to face.

This is exemplified in a more formal manner by the existence of a large number of international professional organizations, concerned with particular scientific fields or subjects and comprised of the leaders in these fields. These organizations periodically bring together outstanding scientists for exchange of ideas, mutual criticism, and marking out of new lines of research along the frontiers of science. Much is owed to them for continued work on such great worldwide problems as tidal waves, sea level and its variation, maintenance of international standards of measurement, long-range radio transmission, epidemic control, health and disease, sanitary engineering, meteorology, and hundreds of other matters of concern to modern civilization and to our national defense. Agencies of this government have also recognized the value to this country of direct, personal interchange of scientific information by convening special *ad hoc* conferences to focus the best minds in science on a problem of particular significance. Of at least equal importance are the contributions of individual foreign scientists to the progress of science in this country through visits to laboratories for periods of research and to universities for lectures or seminars.

Estimates of the number of scientists coming to international meetings or to laboratories and universities in the United States are difficult to make. Compared to the stream of visitors to this country for all similar purposes, including pleasure, which in the fiscal year 1951 comprised more than 300,000 persons, the number of scientific visitors (excluding students) is small, perhaps less than 3000, or 1 per cent, each year. But the scientists who do come here are important to our scientific strength out of all proportion to their number, for they consist, generally speaking, of the best scientific minds of the free world outside this country.

I should point out that the exchange of scientific information with which we are here concerned does not include classified security information. No one questions the necessity of safeguarding such information. Classified research necessarily proceeds without the full benefit of communication in this manner. From the standpoint of progress alone there is no question that this is a handicap, but one agreed to be necessary.

The difficulty with the present system of visitor control has been aptly summarized in the *Bulletin of the Atomic Scientists* (8, 210 [1952]) in the following terms:

> In the past few years a very large number of distinguished European scientists, almost all of them anti-communists and deeply devoted to the freedom in which scientific truth is sought and discovered, have been frustrated in their efforts to come to the U. S. to share their knowledge with their American colleagues. Their applications for visas have in many cases been refused, usually after long delay; in other cases the visas have been finally granted, but only after delays so long that scientific meetings to which they had been invited had taken place, or the teaching appointments for which they had been engaged had lapsed through their failure to arrive in time to fulfill them.

It has been estimated that under the existing statutes at least 50 per cent of all foreign scientists who apply for entry meet difficulties or serious delays. This does not imply that the number of actual refusals to foreign scientists of permission to enter is very great. The principal damage appears to occur in a small number of cases involving seemingly unjustified refusals to outstanding persons,

coupled with the tedious, cumbersome, and uncertain process experienced by those who do pass through the screen. The foundation is, of course, in no position to conclude that in any particular case the decision has been unwarranted. In some cases it is difficult to understand, from the public record, why admission has been refused. However, it is not so much the final outcome in any one case as it is the total effect of the system on our science and upon our scientific relations abroad which is harmful.

The impact of the present situation on the opinion of scientists is evidenced in editorials from leading periodicals in this country and abroad, as well as in published correspondence. A brief bibliography sampling these materials is appended to this statement for the convenience of the commission.

This and other evidence demonstrate a widespread opinion that the system operates in so cumbersome and hostile a manner that many foreign scientists would prefer not to become involved with it. To the degree that this opinion spreads and becomes confirmed, U. S. science is cut off progressively from the contributions of British and Western European scientists and those of other friendly foreign countries. These have, many times in the past, been of great value to progress in scientific fields important as the basis of our progress and security.

We must not imagine that America does not need information and inspiration, and cooperation, from outstanding scientists in friendly foreign countries. We do not have any monopoly on scientific talent or the emergence of new discoveries in science. As I have stated, we benefited perhaps more than any other world power from scientific discoveries made elsewhere. The development of some of the most vital weapons in our armament stems from open, unclassified fundamental scientific research abroad. Radar, the atomic bomb, jet aircraft, and penicillin were perfected in the United States on the basis of discoveries and research in foreign countries to which we were given ready access.

The extent to which the United States needs to draw scientific knowledge from abroad is indicated by an analysis of the nationality of scientists awarded the Nobel Prize. During the first twenty years of this award, 1901–20, forty-three awards were made in physical sciences—fifteen to Germany, twenty-six to other European nations, and only two to Americans. None of the seventeen awards in medicine and physiology went to Americans. Of the sixty awards in the physical sciences in the years 1921–49, forty-four went to European scientists, two to Asian scientists, and fourteen to Americans. Although a considerable number of American scientists have received Nobel Prizes, the fact remains that to date three out of four of these scientific awards have gone to scientists outside the United States.

I am sure that it was not the intention of the Congress, in refining and redefining the security provisions of the immigration and naturalization laws, to impede the progress of science or decrease the military security of this country by adversely affecting scientific research programs. I am just as confident that, once the special problem of science is made known, constructive changes can be expected. I also do not wish to claim that the difficulties we have experienced have been, or are likely to be, catastrophic in their effect on the progress of science in this country—although this is a possibility. My judgment is, however, that the effects of the present policy, if continued for long, can be substantial in slowing down the progress of this country on many important scientific frontiers. The implications, for international relations generally, of alienating a substantial number of the distinguished citizens of friendly foreign countries I leave to those more experienced in political affairs than I. I can say, however, that the implications for science in this country of alienating the foremost scientists and leaders in scientific thought in friendly countries are indeed serious. What has happened, thus, is sufficiently important to the research effort of this country to merit the attention of this commission and, I hope, eventually of the Congress.

What shall be done?

Our survey of the problem, although not an exhaustive one, indicates that there is room for improvement both in the law and in its administration. We are encouraged by the fact, of which we have been informally advised, that the Department of State has been actively investigating all aspects of the visitor visa problem. It seems likely that a satisfactory solution from the point of view of science will require not only improvement in administration by the State and Justice departments but also some revision of the law. For specific constructive recommendations in this field the foundation looks with confidence to the work of this commission and, ultimately, the Congress. We would like, therefore, to suggest some approaches for consideration.

First, let it be said that the foundation recognizes

that rigorous and effective security measures are required under present world conditions to preserve the integrity of our government and our country. We must be protected by adequate safeguards against admittance of undesirable or dangerous individuals on either a permanent or a temporary basis. The foundation believes at the same time that our people can understand that overemphasis on the mechanics of measures for security can seriously compromise security when it cuts us off from access to information vital to our strength. The question is frankly one of proper balance between security by isolation and security by technological achievement.

An important first step toward this end could be taken by making a distinction in the statute between requirements for temporary admission of a nonimmigrant alien and requirements for admission of an alien who intends to become a permanent resident of the United States. Complicated administrative procedures, extensive security checks, exhaustive questionnaires, and careful interrogations should be acceptable as part of an application for permanent entrance and ultimate citizenship in the U. S. The same administrative procedures and criteria are not easily understood or accepted in the case of an application for a visit of a few weeks or months. It is implicit in this suggestion, of course, that strict measures be employed for screening out foreign agents, *saboteurs*, and secret couriers.

The next suggestion is that the criterion requiring exclusion of an alien visitor might rationally become *present, sympathetic* association with a foreign subversive organization rather than, as now, affiliation, in an extremely broad sense of the word, at any time in the past with such an organization. It is encouraging that the Congress has already taken a step in this direction by providing exceptions for persons who in the past were so affiliated but who have terminated such affiliation and for five years prior to the date of application for a visa have been actively opposed to the program of the subversive organization. The change from past to present association might be coupled with a requirement that there be developed a definitive listing, similar to the attorney general's list under the Federal Employees Loyalty Program, of subversive organizations whose character as such has been publicly identified by an authoritative body or officer after due investigation. This would do much, the foundation believes, to assist administrative officers in evaluating the nature of organizations with whom foreign scientists have been associated in one manner or another during the confused and troubled years of the past two decades in Europe.

The foundation's third suggestion grows out of recognition that our government has been accumulating a wealth of experience with security programs in which a balance must be struck between security by isolation and security by technological achievement. In order to ensure that this balance be safeguarded and maintained, it is suggested that consideration be given to providing for selective audit from time to time of applications for temporary admission, by a competent, reliable, and disinterested group with appropriate experience both inside and outside of government.

There is one further possibility that should be considered, particularly if the other suggestions prove to be impracticable. It is a possibility that the foundation advances with some reluctance because it appears to set apart from other alien visitors a separate class—one having outstanding records of achievement in the professions, such as science, scholarship, and technology, and to accord to this class of persons special treatment. The suggestion seems worthy of consideration because it is among this class that the stake of this country in granting prompt admission is often demonstrably the greatest. I have in mind a separate section of the immigration law which, if established, would create a much-simplified and expeditious system for admitting such persons, perhaps defined in terms of those eligible for reciprocal exchange under the *Smith-Mundt Act*—"students, trainees, teachers, guest researchers, professors and leaders in fields of specialized knowledge or skill"—who have applied for admission to this country for a purpose directly related to the activities of a government agency, an accredited institution of higher learning, or a scheduled meeting of an accredited international professional organization.

In giving my views, I speak for the foundation, as director, but I should note that it has not been possible for me, within the limits of the time available, to obtain from the twenty-four members of the National Science Board a direct expression of their opinions. I feel confident, however, that my position is shared substantially by all members of the board. . . .

Geographical Elements in the Toponomy of Mexico

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NEARLY 100,000 inhabited places, each with an average population of less than 300, dot the face of Mexico. Most of these bear Indian names or toponyms. Translated into English, these place names sound strange, exotic, and at times incredible to the foreign ear. Imagine living in a place the name of which signifies "I'll break your jaw!" (Chalco), "In the umbilicus" (Xico), "Where they go downhill" (Temoayán), or "Place of the squashed serpent" (Coapatongo)! In an extraordinary fashion these and thousands of other Mexican place names spell out distinctive facets of the primitive Mexican's attitude toward life, and are evocative of his cultural patterns, beliefs, devotions, his preoccupations.

For centuries his chief preoccupation—and occupation—have been survival. In stoic spiritual and physical devotion the Mexican has had to scratch and coddle the earth to sustain him. Countless tributaries of place names flow toward this central stream of thought. A basic theme directly related to survival is that of the soil and its capacity to yield fruit, or its sterility, as suggested by:

"Land where the soil is humid"	Tabasco
"Stony lands"	Tequemecán
"Sandy lands"	Jajalpa or Xalpan
"In the mud"	Zoquipa
"Where black soil abounds"	Palla

There is a logical profusion of toponymic allusions to agriculture:

"Near the ears of corn"	Miahuatlán
"Place of husked and dried maize"	Tlaollan
"Where there are spicy tomatoes"	Tomacoco
"Where there is much manure"	Cuitlapán
"On the mountain of maize ears"	Xilotepec
"Cotton temple"	Ichcatcopan
"In the land of cornfields"	Centlalpan
"Among fruit trees"	Xocotitlán
"Near the spinach"	Huitznahuac
"Place of many little red peppers"	Chiltecpintla
"Where acid fruits abound"	Xochocotla
"Smooth white pumpkin"	Tzilacaapán
"Where there are many spiny pineapples"	Huitzannaola
"Where the yucca is planted"	Yucatán

A substantial counterpart of the agricultural theme is that of water, which always has been a crucial factor in the Mexican's survival. Much of Mexico is arid, semiarid, or subhumid. As a result, the hydrographic element is conspicuous in Mexican place names. References are made to still and running waters, coloring and taste of water, means of handling it (e.g., damming it for reserve purposes), negotiating it (e.g., with canoes), praising it, noting its scarcity or its plentifulness. To illustrate:

"In the water of shrimps"	Chacalapa
"Where the water divides"	Amaxtlán
"Where housecowners have water troughs"	Apancalecán
"Where there is good water"	Cualac
"Black water"	Olac
"Place of sweat baths"	Temazcalapán
"Where fountains flow"	Axotla
"Near the blue water"	Axotlán
"At the mirrored waters"	Atexcapán
"Where waters gush forth"	Atlacholoayán
"Where there are spiders in the water"	Atocan
"Treacherous waters"	Dexcadi
"Where canoes sink"	Acalaquian
"Where the water can be drunk"	Tacubaya
"The people's water"	Altepetlac
"Where the water is imprisoned"	Altenango
"Where waters divide into many parts"	Atlamajac*

Through place names an observer can readily reconstruct the important part that hunting and

* It is probable that this toponym signifies irrigation ditches.

fishing have occupied in the Mexican scene. Typical of this category are:

"Field for bird hunters"	Totomaixtlahuacán
"Great god of fishing"	Hueipochtla
"Where they fish"	Michmaloyán
"Where they hunt with crossbow"	Atlamaloyán
"Where they hunt for birds"	Netotomaloyán
"Where they capture birds"	Totomaloya
"Place of fishermen"	Michoacán (Michhuacán)
"At fishing waters"	Michapán

A wide variety of faunal references is found among Mexican toponyms—including tigers, deer, javelina hogs, skunks, rabbits, serpents, worms, centipedes, scorpions, bees, flies, sparrows, frogs, fish, and monkeys. As a rule, the organism is simply mentioned, without a modifying adjective. Some exceptions to this are: "Place of the skinny coyote" (Coyoacán), "Place of the mashed serpent" (Coapatongo), and "Where armadillo excrement accumulates" (Ayotochcuitlatla):

"Where rabbits abound"	Tuxtla (Tochtla)
"Where monkeys begin"	Usumacinta
"Where turkeys are plentiful"	Huexolotlán
"Place of the wild pigs"	Ixcoyamec
"Place of rabbits"	Tuchtlán
"On bat hill"	Tzinacantepec
"Where snakes abound"	Coatlán
"Woodlands of wild beasts" (or "Hill of . . .")	Tehuantepec
"Where lobsters are many"	Chapola
"Where worms are plentiful"	Ocuila (Ocuilán)
"Cloud-snake place"	Mixcoac
"Where fierce beasts prey"	Tecualoyán
"The mountain of rabbits"	Tochtepec
"Where there are bats"	Tzinacantlán
"Tiger hill" (or "Ocelot hill")	Otzolotepec
"Near the pigs"	Pizotlán
"Land raised by ants" ("Anthill")	Atzcapotzcalco

The Mexican's concern with health since primitive times is reflected in many of the nation's place names. Although it is highly improbable that the Mexican formerly associated flies and mosquitoes with health conditions, they are included in the representative list below because of their direct bearing upon health:

Where there are hot healing waters"	Atotonilco
"Where there is much excrement in the waters"	Acuitlapán
"Where there are many mosquitoes" (flies?)	Moyotlan
"Wall against mosquitoes"	Moyocalco
"Place of the itch"	Cimatán and Zahuatlán
"Place of medicine preparation"	Oxitipán
"Woman's medicine"	Soapayuca
"Place full of dead people"	Mictlancuauhtla

With respect to war, Mexicans of ancient times were quite up to date: it was an almost constant affair in their world. One of the main motives for the belligerent practices of the Aztecs and other more aggresive tribes was to capture prisoners who might serve as sacrifices to the many gods who were constantly in need of appeasement. Mamatitla ("Among the prisoners") is one place name that tends to confirm what historians have recorded. Tzompanco ("Place where victims' skulls are saved") adds a macabre and curious footnote to the historian's picture. Still other place names tell the story: Quimichtepec ("Hill of the spies"); Mitepec ("Village of war arrows"); and Yautlán, which means simply "Battlefield."

The existence of a polytheistic religion is easily confirmed by means of many toponyms, such as Huehuetlán ("Near the god of fire"), or Churubusco ("Where reigns the sinister god of war [Huitzilopochtli]"), and Mexicalcingo ("Temple of the god Mexitli"), from which *México* is thought to be derived. The word originally was Mexicatzinco ("Temple of Mexitli"). Mexitli, historical etymologists contend, was an Aztec leader who was deified after death. Previous to this time, the place was known as Tenochtitlán ("Place ruled by the god Tenoch"), according to one widely accepted etymology. A date given for the renaming of Tenochtitlán as Mexicatzinco, now called Mexico for short, is July 18, 1327.† Mexicans whimsically advise us to accept the date as correct: " 'Tis better to believe it than to try to prove it."‡

Although the ancient Mexican was greatly concerned with deities, he did not neglect terrestrial affairs. He established many inhabited places on or near mountains. A conspicuous frequency of the *-tepec* (mountain or hill) ending tells us as much: e.g., Ixtepec, Tehuantepec, Miztepec, Ozelotepec, Chapultepec, Pipioltepec, Cuicuitzcatepec, Xocotepec, Xochitepec, Moyotepec, Guaquitepec, Tecpatepec, Tezcatepec, Xaltepec, Xilotepec, Quetzaltepec, Sultepec—to mention but a few of Mexico's jaw-breaking place names in this group.

Mexico's volcanic area is amply strewn with appropriate place names. The name of the latest volcano, Parícutin, is itself a coined word, abbreviated from San Juan Parangaricutiro, the name

† Cecilio A. Robelo. *Nombres Geográficos Mexicanos del Distrito Federal: Estudio Crítico-Etimológico.* Mexico: F. Díaz de Leon Sucrs., 56–62 (1910).

‡ The expression is a proverb, typical of many picturesque Mexican sayings: *"Más vale creerlo que averiguarlo."*

Language groups of Mexico (after Mendizabal Jimenez Moreno).

of the village near which Parícutin erupted. Notable among Mexico's volcanic place names are Popocatépetl ("Mountain that smokes"), Ixtaccihuatl ("Sleeping woman," which graphically describes the mountain's contours), Poctlán ("Place of volcanic eruptions"), Yebusibi ("Mountain of fire that rains down"). Likewise, many places are named after earthquakes: Olinalán ("Place of the trembling earth"), or Olintepec ("Trembling mountain").

Mining long has been an occupation vital to the Mexican. Many localities are labeled with the names of rocks and minerals. A singular conception is embodied in the place name which signifies "gold": Cozteocuitlatl (literally, "heavy yellow excrement of the gods"). By the same token, "silver" is Teocuitlatl. *Coz,* denoting "yellow" has been omitted. Other place names alluding to rocks and minerals are:

Istapangojoya	"Place over salt"
Iztepec	"On the obsidian mountain"
Xiuhuacán	"Place of turquoise"
Tepuzcululán	"Where copper is worked"
Tequesquitenango	"Natural salt waters"
Tepoztitlán	"Among the copper"
Tecpatzinco	"Among small flints"
Tehuitzco	"Place of sharp stones"

Another environmental consideration that has generated numerous toponyms is the climate. Some self-explanatory examples are:

Yoalán	"Where night falls early"
Ecatitla	"Among the winds"
Ecatepec	"On the windy hill"
Ixtapalcalco	"In salty, damp houses"
Tlacipehualco	"Barren place"
Teciuhtlán	"Place of stone rain"
Apipilhuazco	"Where the water hangs freezing"

Contrary to the beliefs held by some tourists that "Cuernavaca" is derived from *cuerno* ("horn") and *vaca* (Spanish for "cow"), the word actually is Nahuatl, a combination of *cuahuitl* ("tree") and *nahuac* ("near"). Dominant Spanish interests during the sixteenth-century conquest of Mexico brought about a change in the original word, Cuahuitnahuac.

A curious mixture of the Spanish and Indian languages is found in some Mexican place names. For example, Minatitlán is named after a General Mina (a Spanish name), with the Nahuatl suffix *-tlán* ("place of"). Similar are Barragantitlán and Polotitlán (after General Barragán and one Señor Polo).

From the foregoing, certain generalizations about Mexican toponyms may be made. Most place names end in a suffix which designates "place of . . ."—e.g., *-co.* Ordinarily not more than three

elements are compounded into any one place name. Frequently one of these elements is a qualifying adjective, which constitutes an index valuable in the study of pre-existent attitudes of the aborigines toward given phenomena. Since the student of the civilization does not have access to the Indian himself, he must study what the Indian has left. This amounts to a content analysis of cultural products.

From a grammatical standpoint, it can be seen that the adjective precedes the noun in compound Indian place names. Some frequent prefixes and suffixes in Mexican toponomy are: *-icpac* ("on," "over"), *-itec* or *-itic* ("within" or "belly", as in Xalitic, meaning "on the sand"), *-nahuac* ("near, around", as in Anáhuac, "near the water"), *-pan* ("on," "over", as in Tlalpan, "on the earth"), *-can* ("place", as in Michoacán, "place of fishermen"), and *-tlan* ("near," "among," "under" as in Cuauhtitlán, "among the trees," or Tenochtitlán, "under the god Tenoch"). *Tla-* means abundance of the object expressed in the name, and *-yan* means place in which the verb of the toponym carries out its action.

The enormously complex language and dialect mosaic underlying the toponymic pattern of Mexico makes any accurate analysis difficult, even for those to whom indigenous dialects and languages are familiar. It has been established that Mexico has used more than 150 languages and dialects.§ Among these, Indian tongues—Nahuatl, Otomí, Mayan, Zapotec, Mixtec, and Tarascan—predominate, although other languages are used by fairly large numbers of people.‖ Nahuatl, the language of the Aztecs, is at present, and was historically, the most widely spoken. It is used principally in portions of Jalisco, Michoacán, San Luis Potosí, Hidalgo, México, Morelos, Guerrero, Veracruz, Oaxaca, and Tabasco, by more than 700,000 Mexicans. Otomí is spoken by some 450,000 persons in Michoacán, Guanajuato, Querétaro, San Luís Potosí, México, Hidalgo, Morelos, Puebla, Veracruz, and the Distrito Federal. Mayan is spoken by about 350,000 people in Yucatán, Campeche, and Quintana Roo. Zapotec is used in Oaxaca by about 250,000 persons. The Mixteca language group is used by more than 200,000 in the states of Oaxaca and Guerrero.¶ Further to complicate the picture, there has been extensive language borrowing and constant linguistic erosion. Both these processes have been accelerated by the rapid development of the modern press, radio, education, and travel, so that with each passing decade it becomes increasingly difficult to establish exact etymologies of Mexican place names. To declare with Orozco y Berra that languages in Mexico have lost their *"pureza primitiva"* is an understatement of the problem.**

Yet with all the accompanying complexities of Mexican place name meanings, the field in its relatively unstructured stage offers the student of the Mexican scene a tremendous store of knowledge pertinent to the long and colorful story of our closest Latin-American neighbors.

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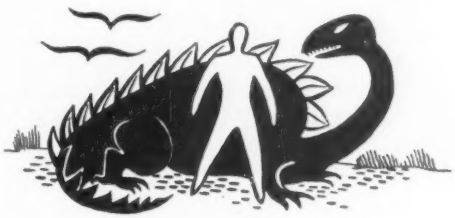
§ Jesús Galindo y Villa. *Geografía de México*. Barcelona: Labor, S. A., 89–90 (1930).

‖ Manuel Orozco y Berra pioneered in studying the geography of Mexican languages; Francisco Pimentel expanded this study and emerged with a fairly comprehensive picture, listing by name 108 languages and several dozen dialects. For English-reading observers, this is listed succinctly in Matias Romero's *Geographical and Statistical Notes on Mexico*. New York: Putnam, 86–88 (1898).

¶ Jorge A. Vivó. *Geografía de México*. México: Fondo de Cultura, 134–5 (1947).

** Manuel Orozco y Berra. *Geografía de las Lenguas*. México, 13 (1886 [?]). This idea is enlarged by José N. Rovirosa in *Nombres Geográficos del Estado de Tabasco*. México: Tip. de la Secretaría de Fomento, 5–8 (1888).



Social Science and Purposive Behavior*

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IT IS not without justice that present-day scientists are still fearful of teleological concepts, for we are not so far distant from the time when the universe was purported to have been created for man and when the doctrine of "proper places" was an accepted dictum. The controversy that raged about instincts is still fresh in the minds of many, and the difficulties of scientific investigation that ensue when one establishes previously conceived ends are still present.

The mechanistic interpretation in physics brought about tremendous achievements in the physical and biological sciences, and behaviorism in psychology impelled investigations of tremendous significance. The application of statistical concepts to the social sciences and the developing application of nonteleological concepts to sociology aided in the development of the sociological sciences. But with all this an important element was being omitted in investigations, one which partially differentiates human behavior from physical events. This element was tied up with emotional valuations which it was advisable to omit from consideration for the time being. But whether we like it or not, human behavior (or even animal behavior) indicates direction. The new fields of psychoanalysis and psychiatry have made it increasingly more difficult to ignore the purposes behind behavior. In addition, problems of learning were seen to be influenced by the state of mind of the individual. Motivation has become an important consideration in many types of problems. The mechanistic interpretation required such stretching to cover so many cases that it began to look as though the mechanistic conception might be inadequate.

* This is a modification of one of the chapters in the author's forthcoming book *The Design of Human Behavior* (St. Louis: Educational Pubs. [1953]).

The development of the social sciences came as a result of the drive to gather facts concerning present conditions in society. In an attempt to avoid premature judgments concerning the meaning of the data, all valuational attitudes were severely repressed. Invaluable results were accumulated and stacked away in libraries and introductory texts. The data were used primarily for the purpose of disproving certain current theories, and no attempt was made, at least for a time, to organize and systematize the information acquired. The attitude which led to objectivity in the social sciences was so intense that it tended to overdo itself, and the source from which the data were derived gradually became overshadowed by the mountains of information about it. The application of statistical techniques induced a search for uniformities in the data, a search which was in line with the current definition of scientific law as a description of uniformities.

Up to this point what was happening was extremely valuable and desirable. But two mistakes were made. First, a careful distinction was not drawn between the emotional valuations of the scientist as a person and the valuations of the persons whose behavior was being studied. In order to avoid subjective interpretations, the social scientist disregarded the existence of objective values in the sense of values which conditioned behavior. Then when a consideration of values was forced upon him, he tried merely to describe them without noting their effect upon the subject who held them. The second error lay in the increasing failure to take into consideration the behaving individual, a failure which gradually began to lead to the hypostatization of mental constructs. The tendency was further illustrated in the introduction into social analysis of "mob minds," "social forces," "organismic theories," etc. Such theories as those de-

veloped by Spengler, Pareto, and in recent days by Sorokin, are the result of treating data in abstraction from the individuals who give rise to those data. Such an attitude makes it difficult, if not impossible, to comprehend social phenomena. For all the laudable effort put into Dodd's *Dimensions of Society,* it is difficult to recognize the results as descriptive of *social* phenomena. Dodd's attempt to quantify is very ingenious. But his variables themselves often involve variables. Until there can be a quantification of values, attempts such as Dodd makes cannot do more than break ground.†

The reasons why individuals behave differently in mobs from the way in which they behave elsewhere cannot be explained in terms of a new "mind," but rather in terms of the motivating forces within the individual. It is perfectly true that individuals act differently under different circumstances; but, again, this is not because some external forces compel them so to act, but rather because of the interplay of values and possibilities. As important as the data concerning crime, tenant farming, education, etc., are, these data acquire meaning only in terms of the values held by the individuals participating in each phenomenon. It is interesting to note that, although the social scientists often speak of the necessity of eliminating purposive considerations in the discussion, for example, of institutions, the leaders in these institutions always act in terms of desired goals.

A consideration of existing institutions and contemporary social phenomena cannot fail to indicate the tremendous importance for any developing society of the values sought by the members of that society. People are not concerned with some mysterious "telos," but with their direct needs and wants. This means that in society, as anywhere that individuals live, certain end states or end objects that the individual conceives as necessary for his (or her) continued existence in a healthful state are the ultimate determining factors in what will happen and what the individual will do. The additional fact that the goals toward which behavior is directed are subject to evaluation in terms of the health of individuals makes a true social science possible. By means of these two complementary concepts, social science can organize its data to indicate desirable directions and to implement social processes in the direction of human well-being.

Perhaps the introduction of the concept of purposive behavior will not give rise immediately, if at all, to laws according to which we can predict absolutely what individuals will do under certain circumstances. But neither can we predict absolutely what will happen when a patient takes one of the sulfa drugs. We know that there will be a reaction, and we know how it will affect the patient if the patient does not react in certain ways to the drug. The concept of purposive behavior in the social sciences will indicate general trends. To take an obvious illustration: if an individual is hungry, then he will seek food, if there are no other interfering motives or conditions. In general, an individual will seek to maintain or to attain health, provided there are no other conflicting motives or circumstances. The reason why an improvement in economic conditions may give rise to an improvement in social behavior lies in the fact that improved economic conditions make available the means for the satisfaction of the needs of individuals. On the other hand, hunger alone will not in itself lead to revolt; nor, conversely, will a sufficient amount of food guarantee a satisfied citizenry. Most people not merely want food, they want it in a certain way and accompanied by certain other values. Some people might starve to death rather than be fed under certain conditions. We know, for example, that many poverty-stricken people would rather go hungry than accept charity. But they might accept the same money or food if they were somehow made to feel that they had earned it. Again, there are individuals who would sooner surrender all dignity and all rights rather than starve to death. The difference lies in the types and the relevant potency of the values accepted by the individual. Ultimately, the significance of statistical frequencies lies not in their correlation with other frequencies of the same type, but rather in their ability to indicate the strength and quality of the values of individuals. There is, then, an element of indeterminacy in all social science. The very attempt to modify a person's values may cause a modification in other values. So, too, a prediction concerning the outcome of a given behavior pattern may cause the person involved to modify that behavior and thereby falsify the prediction.

This analysis goes counter to the complete reduction of social phenomena either to statistical tables or to the effects of forces or movements considered independent from the individuals concerned. Very little is gained if we are told that the present crisis is caused by the fact that man had made machines and had lost control of them. Expressions which indicate that the machine has conquered man or that machines have given rise to social forces beyond the control of human beings

† The literature on method in sociology and psychology is growing rapidly, and no attempt will be made to cite any of it. The reader is referred to the various sociological and psychological journals.

lead us nowhere. No machine can control a human being; the machine ultimately remains a machine. Expressions of this type are either admissions of ignorance, efforts to evade responsibility, or attempts to hoodwink people. The construction of machines and the development of technology have placed in the hands of human beings implements that make the attainment of values much easier. The same machine, if used in one way, can give individuals economic security; if used in another, it can provide profits; and if used in a third way, can give power to the user. The way in which the machine will be used will depend upon the values held by the person who controls it.

In the same way, the appeal to social forces or social energy or to a social organism can lead nowhere. This is not to deny that meaning can be given to such a term as *social force*. A social force may be viewed as an abstraction from individual behavior. The effect of an idea upon masses of people, for example, cannot be denied. But the idea has arisen in the minds of individuals because of the intersubjective system in which they find themselves, and its effect will be upon individuals.

When a craze or a fad or a style sweeps the country these things cannot be treated as social forces, independent of people. The chief reason why a fad takes hold is that it appeals to individuals. Or it may appeal, not directly, but through other motives, such as the desire to mimic celebrities or to be considered up-to-the-minute. It is difficult to stop a fad, not because the fad takes control of individuals, but because of the complex of motives in individuals which causes them to accept that particular fad. In this sense, the abstraction of "social forces" can be accepted. But in no other sense is it a valid conception. The spread of new values, the criticism of old ways of behaving, might induce people to change their values and hence their modes of behavior, but the radio, as an instrument for the propagation of ideas, released no new forces in itself. It is only those who speak through the radio and control the means of communication who may so direct the ideas of their listeners that they will tend to adopt different values and hence change their mode of behavior.

Far more important than the accumulation of statistical data on such social facts as divorce, criminality, and birth rate is the consideration of the values sought. The statistical data themselves are significant as they indicate (1) a modification, (2) a frustration, or (3) the successful attainment of values. Correlations of these rates with climate or geography or economic factors may be significant. But if they are significant it is only because these factors have an effect upon the motives of individuals. That climate does have an effect upon activity cannot be denied; but this does not mean that the climate causes the activity. A great deal of the variation in civilizations can be traced to climatic conditions, not because of any mechanistic influence of the climate upon people, but rather because individuals must adapt to the conditions under which they live. Any attempt to reduce human beings to mere pawns in the struggle of natural elements is an extreme oversimplification of the problem. The recent attempt to reduce history to geopolitics falls into the same category. Actually, geopolitics assumes the validity of the goals of a certain small group of people and, further, that they are superior to the goals of all other individuals. Having made this assumption, the geopolitician considers what resources are needed to achieve the values of that particular group. Geopolitics, as with all so-called realistic theories, begins by decrying values as idealistic or metaphysical or theological, but it ends by smuggling in a set of values accepted by small groups. These realistic theories are propounded in the interest of specific groups of individuals, and are used in an attempt to befuddle other individuals and induce them to surrender other values in the interest of the special groups.

The process of social evolution is one of development and change in the means of acquiring values as well as in the values themselves, for the achievement of values gives rise to the development of other values. More successful modes of behavior, whether discovered as a matter of trial and error or reason, tend to replace out-moded types of behavior. What actually occurs is the individual's adjustment of his values to conditions. The effect of environment upon behavior is conditioned by his achievable and approachable goals. The continual dynamic change which goes on gives rise to continual modification of the means of achieving values, as well as a continual modification of learned values. It is not possible, therefore, to lay down a set of absolute categorical dicta that will hold for any and all circumstances. But this variation cannot be used, as it has been, as an argument against the reality of values or the existence of means for judging them. Ultimately, all goals are to be judged in terms of their positive or negative potentialities. Is a particular mode of behavior conducive to the health of the individual or not? This question can be answered only in terms of the given situation. Although we cannot say that polygamy is an evil in abstraction from the situation in which polygamy occurs, this does not permit

to conclude that polygamy cannot be said to be either good or bad. The judgment must be made in terms of the individuals concerned, as well as the conditions under which they live, but where the health of the individuals is concerned, judgments must be made.

It is evident from what we have said that moral systems must vary. The only conditions under which moral systems could be said not to vary would be conditions of absolute stasis and complete uniformity, conditions that are impossible to achieve. The health of an individual may not at all be reached by those modes of behavior which the individual believes will attain it. Whether or not an individual is healthy is only slightly related to his own opinion. An individual who insists that a given act is indispensable for his health may be completely mistaken. Only where the individual has sufficient knowledge and information concerning himself and his environment is he capable of making proper judgments. Ethical judgments depend upon knowledge and not upon mere opinion. The situation is made even more difficult by the fact that we do not have at present as much information as we would like. Hence, moral judgments are in many cases tentative. Even the physician does not always know what medicine is best for a given ailment. In the case of moral questions, where the individual's health both in its physiological and psychological aspects is to be considered, the problem is even more difficult. But the difficulty present in a great many instances does not necessarily spread to every instance.

It is evident on the basis of what we have said that ultimately all social sciences center around moral questions, questions of "ought." This does not introduce into the social sciences any factors that are not already present, but it is a specific recognition of the basic factor in all human behavior. The reason for the lack of success of various social experiments lies in the failure to recognize this. People who unite to form groups dedicated to certain values should make sure that in no important set of values do they have basic differences. This is, unfortunately, the case in all attempts to set up international agencies for peace while retaining the notions of national sovereignty and national interests. Social experimentation must recognize the existence of values and the concomitant fact of purposive behavior. It is quite possible to study environment or to study psychological processes in abstraction, but this abstraction must be recognized and repaired if inferences are to be drawn from these studies. The social situation is an intersubjective field, consisting in a unity of environment, behaving person, and end state. We have called the social situation an "intersubjective system" to emphasize the fact that there is interaction, not a superentity.

Social therapy will direct itself against one of these three aspects, always keeping in view the values involved and their relationship to the health of the individuals. To improve slum areas will not in itself lead to an improvement in the lives of slum inhabitants. As long as the values which the slum dwellers hold are slum values, no amount of improvement of conditions will be sufficient. The effect which has been found—that is, that with slum clearance there has come a decrease in criminal behavior and an increase in the quality of the actions of slum dwellers—is the result of the fact that improved living conditions make it easier to achieve basic needs, and hence to develop new values. The improvement in the lives of people as a result of slum clearance, housing projects, etc., is an indication of the ease with which values can be modified to fit the environment as well as evidence that the slum values are not innate but learned. The psychological effect of a new suit of clothes is frequently far beyond the value of the clothes. What happens, in fact, is that the new suit of clothes changes the attitudes of others toward the wearer, who then begins to think in terms of a different set of values. Environment has a definite effect upon the behavior patterns of individuals, but this effect is the result of the relationship that exists between environment and the achievement of many values. Where the environment is such that only a few values can be achieved, and all the energy of the individual must be directed toward maintaining himself, very little social progress is possible.

In the same way social therapy will be directed toward behaving persons. Where the individual can no longer achieve his desires, and for one reason or another does not change his behavior patterns, a re-education of the individual must be undertaken. Here, again, the important element is to educate the individual to act in those ways that will enable him to achieve the greatest amount of values conducive to the greatest amount of health for himself. Where the individual cannot be educated into a new mode of behavior, then he may be placed in an institution where he will be prevented from injuring himself and others. In every case we are concerned primarily with things that ought to be sought and things that ought to be done to achieve a state of health. The existence of social problems means the existence of things sought for and things done that are not conducive

to the health of the individuals. The concern which sociologists show for social problems is based upon the destructive features of many aspects of the social situation. It is desirable, therefore, that the social sciences recognize these facts and define both the health of individuals and the conditions conducive to that health. In those cases where social conditions are detrimental, it behooves the scientist to describe the conditions and to propose remedies for them. Social scientists are the physicians of the social system. That they are not accepted as such is due as much to their own mistaken values as to the refusal of people to value them.

Such a point of view will make social experimentation possible. If values are the basic features of social behavior, then clearly the manipulation of these values will be the essential feature in the study of society. The difficulty with any present attempt to experiment on a social basis lies in the difficulty in controlling the innumerable factors that are constantly affecting each other in the social situation, plus the inability to determine what constitute the important factors in a given situation. Statistical correlations indicate interrelationships, but not causation. Recent developments in statistical analysis, known as factor analysis, enable the student of social phenomena to factor out the basic elements in a given set of data, to sift out those elements common to the various sets of data. Obviously, what is not in the data could not be derived from the data. Hence, the elements which in the individual give rise to the phenomena that are measured may frequently be hidden from the view of the investigator. In any case, the obvious fact to which we have referred frequently, that a change of environmental factors does not in itself necessarily bring about new situations, is the keynote of the difficulty of social experimentation. What gives rise to behavior is a value, and if we wish to change behavior and hence social phenomena, we must therefore change the values maintained by the individual. Social experimentation can consist, therefore, in setting up situations in which individuals are given the opportunity to obtain the objects of their behavior and others in which their achievement is frustrated. Or, keeping certain values as constant as possible, environmental factors may be modified to a greater or less degree and their effect upon the values and hence the behavior of the individual noted. A given social situation can be modified and the effect upon the health of individuals noted. Control becomes possible because the control is directed toward the means of achieving values as well as the values themselves. Whether or not a given social policy is desirable, therefore, can be determined by viewing its effect upon the health of the individuals. A great deal of such experimentation does seem to be developing gradually. The experiments on neuroses in animals, and the Iowa experiment on children to determine the effects of group organization, are indicative of the interest in these problems.

We must never swerve from the basic questions that need to be decided in the case of social policy: not a monetary cost or consistency or inconsistency with a given set of institutions or a tradition, but the effect upon the health of individuals. Certain laws are immoral not because lawyers say so or because the Supreme Court decides so, but only because they lead to unhealthy results in individuals. Laws that give rise to inequalities or to injustices, or set up situations in which individuals are compelled to violate them, are not conducive to the health of the individual. Moral standards no matter how ancient, traditions, folkways, institutions, no matter how venerable, are not acceptable if they no longer effect the purposes toward which they were originally aimed, and have not acquired new values. Unless it can be shown that greater ill health would result from abolishing them than from maintaining them, they should be abolished. Social science cannot divorce itself from its applications any more than any other science can. The findings of the social scientists, therefore, as Lynd has pointed out in his excellent book, *Knowledge for What?* are to be tested in their applications to social systems. The laboratory within which the social findings are tested is the social system itself. Once the social scientist recognizes this fact and courageously makes his decisions in the light of the best knowledge available to him, social science will become probably the greatest tool for the improvement of civilization that the world has ever found. But this will necessitate the clear-cut recognition of the existence of values and of the fact that it is the business of the social scientists do determine what is a positive value, as well as the best means of achieving that value within the existing limitations of the intersubjective system.

Some Aspects of Urban Zoology in Great Britain

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IN HIS paper "Biology and Urban Areal Research" in THE SCIENTIFIC MONTHLY (July 1951), Francis C. Evans, of the University of Michigan, comments that "the rise of the city has been possible only through man's domination of his surroundings," and adds, "Behind the disharmonies of the modern urban community there seems to be a lack of effective regulation." The study of the modern city, and of its inhabitants human and animal, as an ecosystem, still awaits comprehensive treatment. It may, however, be of interest to submit the following brief synthesis of investigations made at different times on some of the zoological "disharmonies," and on measures for their effective regulation that are being or might be undertaken by urban man in his efforts toward still more complete domination of his surroundings.

Many of these disharmonies, both physical and mental, are associated with the prevalence of various animal pests, the multiplication of which has been favored by obsolete buildings and building methods. Among the most serious insect pests of present-day cities is the bedbug, stated in 1937 to be the source of greater or less discomfort to over four million inhabitants of Greater London; and it is in the larger cities that it occurs in greatest concentration. No definite figures were available until, from 1936 onward, the Medical Officers of Health of a number of British towns, in accordance with a recommendation from the Ministry of Health, published in their annual reports particulars of the number of houses found to be infested with *Cimex lectularius*, and of those disinfested. From these and other figures, it was possible to prepare tables[1] giving the number of houses known to be infested in each town as a percentage of the total number of inhabited houses. In twenty-three towns for which figures were available, it was found that the known degree of infestation increased, in the great majority of cases, along with the order of magnitude of the town. Thus, of the six smallest towns, with under 25,000 houses each, five had a percentage of infested houses ranging only from 0.12 to 0.30; of the six largest towns, with over 100,000 houses each, five showed percentages ranging from 0.79 up to 2.2; of the towns of intermediate size, the majority lay in the classes of intermediate infestation (between 0.31 and 0.70 per cent). But bug infestation, not being a "notifiable disease," was no doubt commoner than indicated by these figures, which are of interest as suggesting the *relative* conditions in large and small towns, and not as criteria of the absolute degree of infestation or as a basis for comparison between one town and another.

It may be mentioned, however, that the town showing the highest degree of known infestation (2.2 per cent) was characterized by its many rows of back-to-back houses; that is, each house was structurally united to and continuous with three others, one on either side and one behind. Such houses still constituted at the time almost half the total houses in the town, although this proportion was decreasing as a result of large-scale civic replanning. Indeed, the part which improved building design can play in reducing this pest is so important that the Report of the Committee on Bedbug Infestation, issued in 1942 under the auspices of the Medical Research Council, included a detailed section on "Building Design in Relation to Bedbug Infestation." The recommendations deal with the reducing of harborage to a minimum by appropriate attention to foundations, floors and skirtings, walls, roofs, picture rails, etc; and also

with facilitating disinfestation by planning buildings in simple, rectilinear, accessible compartments. Application of the methods recommended will, it is hoped, save future urban dwellers from the experience of housewives living, as recorded by Margery Spring Rice, in houses where "The bugs . . . in the rotting woodwork cause endless extra work in an endeavour to be clean. It has been necessary to sit up at night to keep the bugs off the small baby."

Measures for the control of the chief mammalian pests of urban man, the house rats and mice, may also contribute incidentally to the reduction of the bedbug, which, in the absence of human hosts, may derive sustenance from them. Cases are recorded of bugs surviving in houses that had been empty for over two years, and it is known that they can feed on the blood of rats and mice; though how far they do so in nature is not yet established. In the laboratory they can and do produce a normal number of fertile eggs on such a diet. But, apart from this possibility, the rodent population in itself is well known to constitute, at the least a source of annoyance and anxiety, and at the worst a grave danger to health, for city dwellers. Much research on the numbers and habits of the brown rat (*Rattus norvegicus*), the predominant rat in our towns today, has been published both in Great Britain and in America, and need not be enlarged upon here. The writer may simply mention that in the course of routine examinations of rats undertaken over a period of years for the Cardiff Public Health Department, he inspected in one year 1108 brown rats from a single city refuse dump (now filled in and converted into a sports stadium).

The routine investigations mentioned were, however, mainly concerned with the examination of black rats (*Rattus rattus*)—the rat chiefly found on seagoing ships—for fleas and other ectoparasites. The plague flea, *Xenopsylla cheopis*, the potential carrier of bubonic plague, was found during the late 1920s to constitute 78 per cent of all fleas found on rats from seagoing ships, the remaining 22 per cent being almost entirely *Nosopsyllus fasciatus*, the species associated with the brown rat. Away from the docks, in the city area where most of the rats are of the brown species, plague fleas constituted only 3.5 per cent of the total. The situation in shore premises at the docks was intermediate; though black rats were more numerous than brown, the plague flea numbered only 21 per cent of the total fleas.[2]

It was later found, however, that among rats from shore premises at the docks the percentage of

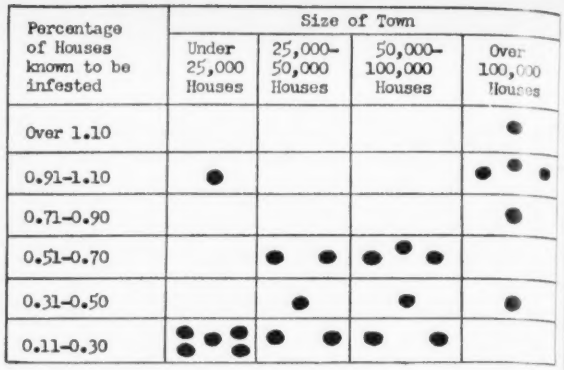

Diagram showing how the proportion of houses known to be infested with *Cimex lectularius* in twenty-three towns in England and Wales generally increased with the order of magnitude of the town. (Based on Matheson, C. *Bull. Entomol. Research*, **32** [1941]).

plague fleas decreased considerably from about 1930 onwards—from 21 per cent to 5.5 per cent. Statistical analysis of corresponding data (which unfortunately are not available) from other ports would be necessary before one could base any conclusion on this; but it may be noted that this decrease began soon after the coming into force in 1930 of the Public Health (Deratisation of Ships) Regulations in 1929. Since then it has been obligatory on vessels coming from a foreign port to produce a deratization (or exemption) certificate issued at an approved port within the previous six months.

These investigations suggested an inquiry into the position of the black rat at British seaports generally; and this was undertaken, with the cooperation of the medical officers of health concerned, just before the outbreak of war in 1939. The results[4] indicated that the average number of rats (almost always black rats) per ship fumigated, and the percentage of shipping requiring fumigation, had declined considerably; that, despite this and precautions taken to prevent passage of rats between ship and shore, several ports still showed an undiminished black rat population on shore—at the docks and sometimes in other places as well; and that in ports which did show a decrease on shore, comparison with the figures for brown rats usually indicated that the decrease applied to both, and was not necessarily related to ship-deratization measures. The black rat seems capable of maintaining itself in some numbers at British seaports without receiving any large recruitments from ships. Commenting on this, the chief medical officer to the Ministry of Health stated in his *Annual Report on the Health of the Nation* that the survey indicated the necessity for

measures against the species not only at docks but at a distance therefrom. The same is true of some seaports in the United States; of the rats taken by the trappers in San Francisco during 1936 and 1937, almost one quarter were black rats, nearly all from the area rebuilt after the great fire of 1906.

This last point emphasizes that special attention to the construction of new buildings is among the most important measures to be taken against the black rat in modern cities, since it appears that the efforts of this adept climber to recolonize seaports have been aided by such developments as the extension of the telephone system and the removal of kitchens from basements to roofs. The sealing-off of floors, ceilings, etc., from upper floors and roofs, and the provision of really effective rat-guards where there is any connection between one roof and another, are among the measures recommended. The brown rat, on the other hand, is of course a burrower, and it is instructive to notice the detailed analysis made at Manchester of the causes of rat infestation. During the three years 1934–36, 5791 premises were found to be infested, and in 67 per cent of these the infestation was due to, or associated with, defective or disused drains or sewers. Similarly at Glasgow, "rats were found to be gaining access . . . through apertures in the walls under the ground where service pipes such as gas, water, drains, etc., entered the buildings. . . . More care should be taken to seal all openings in walls."

The part played by domestic cats and dogs in the destruction of house rats and mice is difficult to assess* and is probably overestimated; though it may be suggestive that of a representative sample (about 3000) of Cardiff households from which information was obtained the percentage which kept a cat ranged from only 30 per cent in recently built housing up to 75 per cent in older dilapidated districts, where rodent pests are likely to find suitable harborage. Some breeds of dogs, such as terriers, may also contribute to rodent control.

On the other hand, both species are the hosts of a number of animal parasites, some of which are transferable to man, and the dog as a factor in street accidents receives considerable publicity in the press of Great Britain, where the animals are often allowed to wander at will. Actual figures supplied by ten towns of varying size in Britain indicate that dogs are concerned, as victims or in some other way, in rather under 200 out of every 1000 street accidents in these towns, and that, of these, four or five may result in injuries to human beings. Records of people bitten by dogs in these towns indicate (even allowing for unreported cases) that in proportion to population this is a negligible trouble. In any case the eradication of rabies in this country by stringent quarantine regulations has banished the danger once so commonly associated with dog bites, although the danger is still appreciable in towns in the United States and elsewhere. (These and other aspects of the influence of the dog in urban communities are discussed in a paper awaiting publication.[5])

The keeping of domestic animals, however, should probably be associated less with the health aspects of urban zoology than with the less easily assessable psychological needs that are due to the almost complete severance from nature of many modern city dwellers. One need not be a psychologist to appreciate the significance of the contrast between the early medieval town, which Mumford in *The Culture of Cities* describes as "adequate . . . on the biological side," with its cows and horses, its houses where "one awoke . . . to the crowing of the cock, the chirping of the birds nesting under the eaves," and the twentieth-century towns where, for example, "most of the inhabitants of modern Scotland . . . grow up out of touch with nature, the rhythm of the seasons, and the relationship of man to the soil. Their mental conditioning by a man-made environment of concrete and steel, stone and brick, must profoundly affect their outlook."

Robert Sinclair, in his *Metropolitan Man*, mentions that, of a class of London senior schoolgirls before the war, five had never seen a live cow. Even the horse, familiar for much longer on city streets and quaysides, has in many towns practically disappeared.

> Among all the sights of the docks [wrote Herman Melville† of his visit to Liverpool a century ago], the noble truck-horses are not the least striking to a stranger. They are large and powerful brutes with such sleek and glossy coats, that they look as if brushed and put on by a valet every morning. They march with a slow and stately step. . . . The truckmen themselves are almost as singular a race as their animals. Like the Judiciary in England, they wear gowns—not of the same cut and colour though—which reach below their knees, and . . . hobnailed brogans. . . . They are a reserved, sober-sided set . . . spending so much of their lives in the high-bred company of their horses. . . .

Even in 1921 there were in Liverpool 2078 stables containing 9940 horses; by 1934 there were only 1066 stables with 4168 horses.

* See, however, Jackson, W. B. *J. Mammal.*, **32**, 458 (1951).

† In his partly autobiographical novel *Redburn*.

> The majority of carters [observes the *Merseyside Social Survey* carried out by the University of Liverpool] are engaged about the docks, carrying goods from the quayside to the railway or warehouse. . . . Today, not only are goods generally loaded into or unloaded from railway wagons at the quayside, but motor transport has in many cases replaced horses . . . as might be expected in a declining trade, there is little recruitment of new entrants. . . . With the decline in importance of the trade, there seems to have gone a certain decline in the professional pride of the carter. A generation ago, we were told, the carter had his own uniform of white moleskin trousers, which were always clean on Monday morning, blue coat, blue socks, and heavy boots, with a special kind of apron. Today these have been replaced by corduroys and even by fancy socks and shoes.

For many townspeople today, therefore, the domestic cat or dog may represent their only contact with the world of four-footed creatures familiar to their ancestors; and further reduction of such contact by restrictions on keeping cats and dogs, which various corporations (no doubt rightly) have judged necessary both in old tenements and in new blocks of flats, has aroused protests from tenants in many towns. Where the separate-house-with-garden principle is practicable, the wishes of such tenants may be reconciled in greater degree with the legitimate requirements of their neighbors. No statistics on the numbers of urban cats are readily available; but an investigation[6] made in two of the largest towns in Wales—Cardiff and Newport—indicated that house-kept cats probably numbered at a minimum about 10.5 per cent of the human population. In addition, the numbers of stray cats destroyed annually in large towns, by the Royal Society for the Prevention of Cruelty to Animals and similar organizations, may range from 1 to 3 per cent of the human inhabitants: Edinburgh, 1 per cent; Glasgow, 2 per cent; Liverpool and Cardiff, 3 per cent; and Boston, 3 per cent. The minimum number of dogs, as estimated from the licenses issued in each of ten towns in Great Britain, approximates fairly closely in most cases to 5 per cent of the human population.

As a counteractive to the "man-made environment of concrete and steel, stone and brick" may be mentioned the emphasis laid on additional parks and open spaces in the new town-planning schemes. "Parks are, in fact," say Hesse, Allee, and Schmidt in their *Ecological Animal Geography*, "the type of situation richest in bird life in the temperate latitudes." In the satellite garden city of Wythenshawe, for example, with 1000 acres reserved for a permanent agricultural belt and another 1000 for open spaces out of a total of 5500 acres, and with its wide pathways bordered by trees and flowers, bird life will find many more favorable haunts than in the parent city of Manchester.

It need hardly be stressed that the data available for some of the foregoing inquiries were of a provisional and incomplete nature. They provide, however, within their limits, a preliminary picture of the ramifying interrelations of urban man and urban fauna. Such a picture should prove useful in efforts to rectify, from the biological aspect, the lack of effective regulation that lies behind some of the disharmonies of modern urban communities.[7] An exhibit embodying much of the foregoing information has, for some years past, attracted considerable public attention in the Department of Zoology in the National Museum of Wales.

References

1. Matheson, C. *Bull. Entomol. Research*, **32**, 165 (1941).
2. ———. *Ann. Rept. 1934, Cardiff Medical Off. Health*, 121 (1935).
3. ———. *J. Royal Sanit. Inst.*, **62**, 128 (1942).
4. ———. *J. Animal Ecol.*, **8**, 76 (1939).
5. ———. *J. Royal Sanit. Inst.* (in press).
6. ———. *J. Animal Ecol.*, **13**, 130 (1944).
7. ———. *J. Royal Inst. British Architects*, 3rd. ser., 50, 279 (1943).

SCIENCE ON THE MARCH

A BRONZE STATUE FROM MAREB, YEMEN

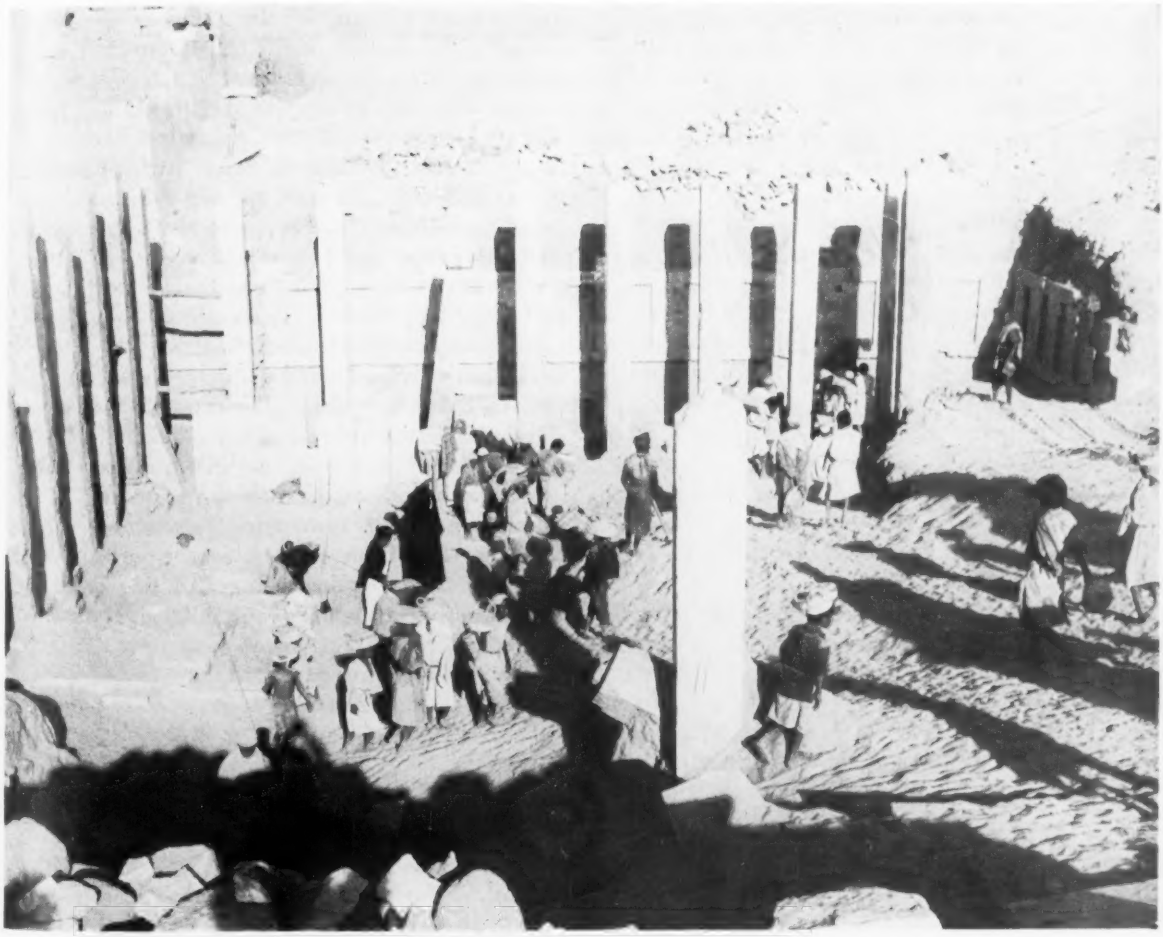

FIG. 1. On February 12, 1952, owing to the collapse of local security, the American Foundation for the Study of Man's archaeological expedition to Mâreb, Yemen, capital city of the Queen of Sheba, ceased excavating the above monumental eighth-century B.C. temple of 'Ilumquh (dedicated to the moon-god, premier deity of ancient Sheba). Under the leadership of Wendell Phillips, the expedition members escaped across the desert to eventual safety in the Wadi Beihan, Western Aden Protectorate, leaving behind in Yemen all expedition equipment, supplies, and recently discovered Sabaean bronze and alabaster sculpture.

THE short but exciting Yemen expedition of the American Foundation for the Study of Man devoted itself at Mâreb to excavating the great Himyaritic temple known as Maḥram Bilqis (Fig. 1). A large, oval structure, it was built in the eighth century B.C., was named 'Awwâm, and was dedicated to the moon-god 'Ilumquh, as may be learned from an inscription on the outside of the temple. Circumstances permitted complete excavation only of the entrance hall, which consisted of a court surrounded by a peristyle. Among other things uncovered were three bronze statues and the foot of a fourth, all found 35–100 cm above the floor of the forecourt of the temple.

It was the custom of ancient devotees of the moon-god to offer to their deity one or more statues set on a stone base containing a dedicatory inscription. Variant forms were: (1) the inscription cast on a metal (bronze, so far as is known) plaque fastened to a plain stone base; (2) the in-

scription on the front of the statue itself with the base plain; (3) the inscription on a metal (bronze) plaque, occasionally on stone, without statuary.

The largest of the three statues, which was found lying on its left side at the base of a pillar, measures 93 cm. It represents a man who, with head erect, is walking rather stiffly, with a slow and determined step (Fig. 2). Both fists are thrust out before him, with the upper arms nearly vertical and the elbows bent; in his right hand he probably once held a staff or scepter, which is now missing, leaving only a hole through the fist where it had been inserted; in the left he still holds between the second and third fingers his official seal, the design on which now appears only as an oval boss. Statues as large as this are rare, although, judging from footprints on other stone bases, they were occasionally more than life size.

In the statue found at Mâreb the man's skirt, a rectangular piece of cloth, is wrapped snugly around his thighs, with the right end overlapping the left. The open end of the skirt, being pulled taut about the waist, creates an interesting curved line from above the left hip to the center front. The difference in circumference in the top and bottom of the skirt causes the left end to hang slightly lower, thus breaking the otherwise straight line at the bottom. A broad belt hides the top edge of the skirt. It is of even width, without knot or buckle, except for two narrow ends hanging down the back, which are probably intended to represent loose ends or tassels. Stuck into the belt, a little to the right and pointing toward the center, is a sheathed dagger, or *jambîya*. The scabbard is straight, with a slightly bulging round end. The handle of the dagger is thick at hilt and butt, and studded with four large rivet heads. Such *jambîyas* are still carried in South Arabia, but the scabbards have turned-up points.

Over the man's back a lion skin is draped—its forepaws crossed in front across his chest, its hind paws gripping his thighs. No clasps for holding the paws in place are indicated. The lion's head hugs the back of the man's neck, and its tail hangs to the back edge of his skirt. The head of the lion is small and almost unrecognizable, and the paws look like human hands. Apparently the lion skin was extremely thin, for the shape of the man's shoulder blades is distinctly visible through it.

On his head is a thick, knitted cap—indicated by three rows of knobs—encircled by a double band of ribbons, which are tied on the left side just above the ear. On the right side the ribbons project abruptly, leaving a small hole for the insertion of some ornament, such as a feather. Above the ribbons the rows of knobs, converging to a point at the crown of the head, become narrow and indistinct.

The torso is modeled in broad, flat planes. Two small folds of flesh at the base of the neck probably represent the collar bones. The legs are straight, with a sharp ridge running down the front, and a curved incised line, from the ankles to the knees, outlining the muscles of the calves. Another sharp ridge runs up the front of the neck, which is slightly conical, tapering upward to the broad, stiff head. The eyes are large and conventionalized—the irises being indicated by incised circles in the center of the eyeballs. The eyebrow, a sharp ridge above the eye socket, follows the curve of the upper eyelid. The nose is large, arched in profile, and the nostrils are deeply indented. The mouth is a narrow slit, and a lightly incised line runs down each side of it from the nose to the chin. A beard of tight curls, indicated by rows of knobs, extends from the temples to below the chin. The ears are large and simply modeled, with large bulbous lobes.

This is a statue of a man whose name, Ma'adkarib, indicated on the anterior part of the shoulders, is well known in Qatabanian and in Sabaean. The front of the statue is covered with a lightly engraved inscription running from the shoulders to the bottom of the skirt, and continued on the right knee:

'mdhr/bn/lh	'Ammdaḥar, son of Laha-
y'tt/bn/kr(?)	y'aṯaṯ, of [the family of] Kar(?)a-
t/ḥqny/'l	t, has dedicated to 'Il-
mq]h/slmn/dhb	umq]uh, this statue in bron-
n/. . . .	ze . . . .

The first name, 'Ammdaḥar, is specifically Qatabanian, as shown by the name 'Amm, "moon-god," principal divinity of the kingdom of Timna'. An example of this name was found in Mukêrâs. The father's name, Lahay'aṯaṯ, is also found frequently in Qatabanian. At the beginning of line 4 the letters "mq" of the name of 'Ilumquh, moon-god, principal deity of Saba', can be restored. There is no clue to the relationship between 'Ammdaḥar, the donor, and Ma'adkarib, the person represented by the statue.

A longer inscription appears on the chest of the second statue from this same group:

yṯ'mr/wmyṯ'/ntlynhn/	Yaṯa'amar and Muyaṯa' Ñatlaynahân,
bny/šr'hmw/hqny/'lm	of [the family of] Šara'humu, has dedicated to 'Ilum-
qh/b'l/'wm/mṯlnhn/	quh, lord of 'Awwâm, these two statues

dhbnz wbnyhmw/zy	in bronze and their two children Zay-
d'l/wkrb'tt/bdt	d'il and Karib'atat, because
hwfyhmy/'lmqh	'Ilumquh has accorded them [: the two children]
dt/tnb'hw/	that which he [:'Ilumquh] promised him [: Yata'- 'amar]
wyhwfynh	and whom he may pro-
mw/b'ttr/	tect. By 'Attar
w'lmqh	and 'Ilumquh.

'Awwâm (actually Mahram Bilqîs) is the temple of 'Ilumquh, as the text indicates, but also of "Bull Lord," another name for the same divinity. The final invocation cites 'Attar, stellar god habitually put first in the invocation, and 'Ilumquh, the principal lunar god of Saba'.

The statues were probably intended as portraits: the first that of Ma'adkarib, whose name is inscribed on the back, the second and third those of the two sons of Yata"amar, who, according to the second inscription were consecrated to the divinity as well as being represented by the two statues. The reasons for the dedications, as stated in the second inscription, were: (1) gratitude for a special favor, and (2) petition for protection in the future.

Stylistically, the first statue is reminiscent of Phoenician sculpture and has its closest parallels in Phoenician and Cypriote statuary from the eighth to the sixth centuries B.C. South Arabia was connected with Phoenicia by trade relations beginning not later than the tenth century B.C.

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FIG. 2. Front view of bronze statue of Ma'adkarib. In spare moments the explorers restored the broken right foot and left arm with iron rods and cement and mounted the statue on a stone base. Ma'adkarib thus stands majestically surveying the modern Mâreb much as he did the ancient city centuries ago.

GRASS HERBICIDES IN TODAY'S AGRICULTURAL ECONOMY*

THE idea of grass as a weed is, justifiably, quite far removed from the mind of the average person. The mental image evoked by the word "grass" varies with the individual, but in most cases it is a pleasant picture. The city man visualizes fairways, parks, and home lawns, the stockman sees endless miles of Western rangeland, and the agriculturist pictures fields of small grains. Man has been increasingly dependent on grasses for his food ever since the first nomads began to give up their precarious hunting life for the surer returns of tillage. As a result, this close association has fostered most of the world's greatest civilizations. The rice culture of Eastern Asia, the wheat and barley culture of Europe and the Near East, and the maize culture of pre-Hispanic America all owe their development to this unique and generally beneficial plant family.

As in many families of the plant or animal kingdom, however, there are certain undesirable species present in the family Gramineae that interfere with man's productive activities. The presence of such species may cause reduced yields of desirable crops, render cultivation difficult or even impossible, and cause injury to grazing animals on either green or dry feed. The Biblical reference to the useless tares among the wheat (Matt. 13:24–30) would seem to indicate that grassy weeds have been plaguing agriculturalists for many centuries. This particular grass, a species of *Lolium* commonly called Darnell, still infests fields of the Mediterranean lands as it did well over two millennia ago. Today's grass weed problems, both in the United States and abroad, rank in importance with those involving broad-leaved weeds, and are frequently more baffling. Efforts of federal agencies, state universities, agricultural chemical companies, and many individual farm operators have been pooled in attempts to lessen the effects of weed grasses on current production.

Areas of Economic Importance

In sheer acreage, India can probably lay dubious claim to the world's worst grass infestation. It has been reported recently[1] that Kans grass (*Saccharum spontaneum*)† has invaded 10 million acres of needed agricultural land. An aggressive relative of our domestic sugar cane, Kans poses a grave problem in a land that is both seriously overpopulated and underfed. In the sugar-cane fields of our own Gulf states, an acre of land infested with Johnson grass (*Sorghum halapense*) may contain as high as 9 tons of rhizomes, or underground stems.[2] Other serious creeping perennial pests are quack grass (*Agropyron repens*), Bermuda grass (*Cynodon dactylon*), and Reed canary grass (*Phalaris arundinacea*). These species are tough and persistent and present a constantly recurring problem, inasmuch as they propagate readily from rhizomes or stolons. In the Southwestern United States a water-loving perennial called Carrizo cane (*Phragmites communis*) blocks irrigation systems, and its control represents a substantial cost in yearly maintenance of the canals.[3]

The scope of grass control is not limited to perennial grasses alone. These species are confined mostly to humid regions, or to those irrigated arid lands where winters are mild. Annual grasses, on the other hand, are present in all climates where agriculture is possible, and frequently become a more serious problem than perennials. Crab grass (*Digitaria sanguinalis*), a universal lawn pest, reaches its optimum in the Gulf region, where it is generally recognized as the Number One weed in cotton culture.[4] Its success accrues from a prolific seed production, coupled with a dormancy factor which insures a ready supply of seed in the soil for several years ahead. In the sugar-beet belt along the eastern side of the Rocky Mountains the dominant weed is wild oats (*Avena fatua*), and much research has been expended in seeking an economical control.[5] Each cultivation, in turning over a furrow slice of infested soil, creates the aerobic conditions necessary for seed germination. On several million acres of rangeland in the Great Basin states and adjacent areas cheat grass (*Bromus tectorum*) has invaded depleted and worn-out perennial grass and sagebrush mixtures. This prolific and aggressive species ripens early, is undesirable as forage, and constitutes a tremendous fire hazard when ripe. In addition, the sharp awns cause mechanical injury to the mouth parts of grazing animals, thus leading to secondary effects such as actinomycosis, or "lumpy jaw." Other universally distributed weedy annuals include foxtail millet (*Setaria viridis*), barnyard grass (*Echinochloa crus-galli*), witch grass (*Panicum capillare*), and sandbur (*Cenchrus pauciflorus*). A short-lived perennial closely resembling an annual in its habits

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† This and subsequent scientific names found herein are those given in Hitchcock and Chase's *Manual of Grasses of the United States*, 2nd ed. Washington, D. C.: GPO (1950).

is foxtail barley (*Hordeum jubatum*), a pasture and hayland pest found ordinarily under conditions favoring a high water table. These small-seeded pests create a yearly problem of control in many crops and add measurably to the cost burden borne by the farm operator. In addition to the direct costs of cultivation, other costs, such as the expense of seed cleaning, are frequently directly related to the presence of weedy grasses on agricultural lands.

Methods of Grass Control

Until very recent years, the chief method of grass control was the traditional one of "hoe and pull." The advent of cultivation machinery materially speeded up this chore, but in-the-row weeding still remained largely a laborious hand procedure requiring cheap and abundant human labor. Fields have often been abandoned as hopeless, and farmers forced to relinquish the investment of a lifetime, because of invasion by quack grass and other noxious grasses. In the late 1920s and early 1930s the chemical industry began to explore the possibilities of herbicidal compounds, and several materials were duly evolved which successfully destroyed vegetation. The borates, chlorates, and arsenicals now widely used as soil sterilants were developed during this period. None of these, however, filled the basic need for a herbicide which would kill grasses, yet leave the soil in suitable condition for cropping. Their usefulness therefore became limited to the eradication of spot infestations or to soil sterilization along fence rows, ditchbanks, and in farmyards or driveways. Other than this, the only practical control approach prior to World War II was frequent cultivation.

Unlike the broad-leaved weed species, grasses have a natural defense mechanism against most foliage-type herbicides such as 2,4-dichlorophenoxyacetic acid (2,4-D) and dinitro-*o*-secondary butyl phenol (DNOSBP). First of all, the little-understood metabolism of grasses differs from that of dicotyledonous plants in that 2,4-D (broad-leaved weed-killer) produces only a fraction of its usual growth-regulating effects. This means that most hormone-type herbicides are not satisfactory control agents for weedy grasses. A second factor involved, largely physical, is that narrow grass leaves are difficult to wet with a spray solution, even when a wetting agent or "sticker" is employed. The third, and certainly a vital factor, is that the growing point, or region of greatest meristematic activity, is at the base of the plant. The sheltering effect of top growth, plus the usual presence of some ground mulch, acts to protect this growing point. For these reasons very few contact sprays, such as DNOSBP, are useful on grasses unless applied when the grass plant is in the very earliest seedling stage.

Carrizo cane (*Phragmites communis*) infesting an irrigation canal near Reno, Nevada. Oil-type herbicides now materially reduce the labor involved in cleaning these grass-clogged systems, but the effects are only temporary. New work with CMU and TCA-2,4-D combinations may eventually provide an effective means of root-kill.[3] Formerly, control could only be accomplished by expensive mechanical means. (U. S. Bureau of Reclamation.)

The first successful forward strides were made when chemists and plant physiologists in England during the early days of World War II began experimenting with a host of chemicals to find something selective toward grasses. Out of these trials a single chemical family showed promise, the *n*-phenyl carbamates.[6] The most active member, *o*-isopropyl *n*-phenyl carbamate (IPC), prevented the emergence of many types of weedy grasses when applied to the soil in light concentrations. With this discovery, interest in grass herbicides expanded rapidly. From England IPC was brought to the United States, where several researchers began attempts to apply it in our own agricultural system.[7, 8] Meanwhile its action was determined to

Sugar-beet field in northern Colorado where foul growth of wild oats (*Avena fatua*) frequently limits production. Left, untreated area; right, IPC applied at 6 pounds per acre and disked in prior to planting. Selective action accounts for the excellent stands of sugar-beet seedlings on the treated area. (Great Western Company.)

be nonsystemic, apparently consisting of mitotic poisoning in the root tips, with a gross effect similar to that produced by colchicine treatment.[9, 10] Nongrassy crops such as legumes, beets, and onions required much higher dosages in order to exhibit the same symptoms.

At about the same time another research group in the Midwestern United States became interested in finding a chemical suitable for controlling local perennial grasses. The most outstanding results were achieved with the alkali and ammonium salts of trichloracetic acid.[11] The most satisfactory member of this group was sodium trichloracetate (Na-TCA). Although the physiological action of TCA has never been satisfactorily described, it is considered to be one of the so-called alkaloid reagents, and therefore capable of precipitating protoplasm.[12] In low concentrations, TCA applied to the soil killed germinating seedlings, just as IPC did, but at very high rates functioned more as a powerful, though temporary, soil sterilant. At light concentrations, crops such as beets, tomatoes, and onions were selectively weeded of annual grasses by TCA.[13]

For several years following World War II the prestige of grass herbicides was at a low ebb. This was partly due to the more successful use of 2,4-D and 2,4,5-T on other weed problems, but mostly it was a direct result of the inconsistencies obtained in field trials following the preliminary studies. In some areas workers abandoned the materials, or else concentrated on the nonselective eradication of plant life on nonagricultural locations. Other workers, who felt that certain keys were needed for the successful application of pre-emergence herbicides, kept up their explorations on a small scale in the hope of eventually finding the critical clues. New interest in graminicides was kindled in 1949 by the discovery of maleic hydrazide (MH), a hormone-type compound exhibiting systemic action in established grasses.[14] Applied to foliage, it inhibited growth, flower formation, and the development of viable seed.[15–20] Further studies revealed that MH inhibited respiration, with the inference that dehydrogenase activity was affected.[21] MH is still comparatively new, and its possibilities have not been fully exploited.

New evidence meanwhile began to supply an-

swers regarding some of the failures obtained with IPC. Workers in the Northwest reported that IPC functioned best against members of the subfamily Festucoideae, and that a newly introduced relative, 3-chloro-IPC, appeared superior against species of the subfamily Panicoideae.[22] In addition, it has been consistently demonstrated that soil type, moisture conditions, temperature, and date of application are critical factors which must be considered in using the carbamates.[23–25] Cultural practices are also involved. This year several thousand acres of peas in the Palouse region of the Pacific Northwest were treated with IPC for control of wild oats, with highly profitable yield increases.[4] In the Rocky Mountain area, after four years of research, technologists have perfected the application of IPC for weeding wild oats out of sugar beets.[5] Spraying schedules will be a part of the general field plan for several thousand acres of beets in the 1953 season. In both instances the key to success of the treatment appears to be direct incorporation of the chemical into the soil at the time of ground preparation. In dry climates such a procedure obviates the necessity for rainfall in moving the material to the root zone of the germinating wild oats.

3-Chloro-IPC has been found effective in killing cheat grass without injury to desirable perennials.[26] This has particular significance to the grower of grass seed, to the owner of irrigated pastures, and to the rancher in the cheatgrass areas of Oregon, Idaho, Montana, and elsewhere. When

Prolific seeding of annual cheat grass (*Bromus tectorum*) accounts for its unmatched ability to invade depleted perennial grass range. Here the dry "rough" and current year's crop of seed mask a relict stand of blue grama (*Bouteloua gracilis*), reduced to about 20 per cent coverage by many years of overgrazing.

Mature plants of foxtail barley (*Hordeum jubatum*). Ripe awns of this species cause mechanical injury by working their way into the mouth parts of sheep and cattle.

Test plant of *Hordeum jubatum* sprayed with maleic hydrazide at the rate of 3 pounds per acre. Although the same age as plant shown in preceding photograph, flowering has been markedly inhibited without injury to leaves.

Some of the sheep pictured here suffered injury and subsequent infection from grazing in these ripe stands of foxtail barley. The sharp awns are hygroscopic and twist into the flesh whenever they become attached. C-IPC controls seedlings of this pest, but established plants are not affected.

sprayed on the ground surface during the cool months it does not break down readily, and the residual effect after eight months is known.[15] 3-Chloro-IPC also controls crab grass in cotton, and was eminently successful during the current season in the Mississippi Delta area.[4] The use of IPC and 3-chloro-IPC appears to be restricted to those areas where the planting date occurs in early spring and where weed growth can be expected almost immediately following planting. Hot, humid weather causes the rapid breakdown of these materials, and for this reason they are not suited to certain types of agriculture where late planting is practiced.

Use of Na-TCA has now become widely accepted for both perennial and annual grasses, particularly in the South and Southwest. Since sugar cane exhibits a curious tolerance to TCA, the situation is made to order for controlling Johnson grass. Best results have been achieved where a combination of cultivation and chemical has been employed, reportedly excelling either approach used alone.[27] Apparently the exposure of the rhizomes enhances the effectiveness of TCA. Other uses of TCA have been developed for controlling small-seeded annual grasses in sugar beets and other crops, without serious injury to the crop plants themselves.[13]

Although not strictly graminicides, mention should be made of the usefulness of certain dinitrophenol and hydrocarbon herbicides in controlling seedling grasses. In areas where these materials are plentiful and reasonable in cost, many annual grass species may be killed in the early emergent stage. Established perennials are not seriously affected, as these materials kill only tops. DNOSBP, certain weed oils (both olefinic and aromatic), and hydrocarbon by-products of the petroleum industry compose the bulk of this class of compounds. A new addition to this general group has been recently introduced in the form of shale oil herbicides.[28]

Chemists are also exploring more new compounds every year for possible new and superior grass herbicides. Examples of recently released experimental compounds are 3-*p*-chlorophenyl-1, 1-dimethyl urea (CMU) and disodium 3,6-endoxohexahydrophthalate (Endothal). These materials are showing particular promise and may eventually occupy a definite place in control of grass weeds.

Unsolved Problems in Grass Weed Control

The new respect with which grass herbicides are regarded by no means implies that an end point has been reached in their development, or that untouched problem areas do not exist. On the contrary, all that has been achieved in the past eight or nine years represents a mere scratching of the surface possibilities, both in the United States and abroad. A challenging and far-reaching problem exists, for instance, in the reclamation of the annual grass ranges of the California coast area.[29] For many years plant breeders have been attempting to find perennial species that will become established and crowd out the annuals, but with little practical success. The very definite possibility exists that chemical eradication, closely followed by reseeding with desirable perennial grasses, may one day find a practical application in this large area. Another compelling problem involves the reclaiming of millions of acres of relatively low-value cheatgrass range in the West. The difficulty lies in reducing the cost per acre to a level of economic feasibility, perhaps by means of low-volume airplane application. Certainly the Kans grass problem in India will have to be met squarely, and the difficulties of chemical spraying in a country with only negligible numbers of power applicators will call for the best in research ingenuity.

Each climate has its special grass weed problems, and no one method or material has yet found universal application. Exploration in the field of graminicides has therefore become an urgently necessary adjunct to the whole agricultural research program.

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References

1. TIMMONS, F. L. *Foreign Agr.*, **16**, (5), 99 (1952).
2. STAMPER, E. R., and CHILTON, S. J. P. *Down to Earth*, **6**, (4), 9 (1951).
3. SHAW, J., and BOWSER, C. Private communications (Oct. 1952).
4. WITMAN, E. D. Private communication (Oct. 1952).
5. NELSON, R. T. *Through the Leaves*, **40**, (4), 10 (1952).
6. IVENS, G. W., and BLACKMAN, G. E. *Symposia Soc. Exptl. Biol.*, **3** (1949).
7. ALLARD, R. W., *et al. Botan. Gaz.*, **107**, 589 (1946).
8. MITCHELL, J. W., and MARTH, P. C. *Science*, **106**, 15 (1947).
9. DOXEY, D. *Ann. Botany* (London), **13**, 329 (1949).

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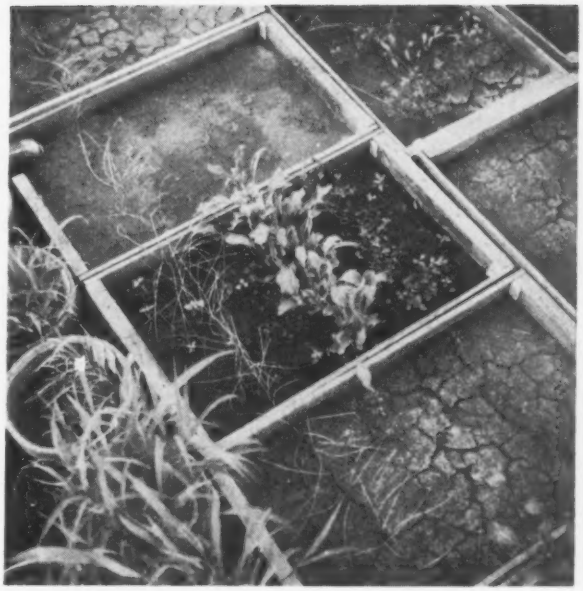

Composition of soil affects selectivity of grass herbicides. When TCA was applied at 15 pounds per acre to these flats, all weedy grasses were killed. However, on the sandy soil (upper) and clay soil (lower) the crops of sugar beets, alfalfa, and sweet clover were suppressed. Only on the loam (center) was selectivity apparent. Direct factors appeared to be the higher percentages of organic matter and fertilizer elements present in the loam. Note tolerance of onions.

10. ENNIS, W. B. *Am. J. Botany*, **35**, 15 (1948).
11. MCCALL, G. L., and ZAHNLEY, J. W. *Kansas State Agr. Expt. Sta. Circ. 255* (1949).
12. HILL, G. A., and KELLEY, L. *Organic Chemistry*. Philadelphia: Blakiston (1943).
13. BARRONS, K. C. *Down to Earth*, **6**, (4), 8 (1951).
14. SCHOENE, D. L., and HOFFMAN, O. L. *Science*, **109**, 588 (1949).
15. BLOUCH, R. M. Unpublished master's thesis, Colorado A & M College (1952).
16. CURRIER, H. B., and CRAFTS, A. S. *Science*, **111**, 152 (1950).
17. CURRIER, H. B., DAY, B. E., and CRAFTS, A. S. *Botan. Gaz.*, **112**, 272 (1951).
18. ENGEL, R. E., and AHLGREN, G. H. *Agronomy J.*, **42**, 461 (1950).
19. GREULACH, V. A. *Texas J. Sci.*, **2**, (2) 219 (1950).
20. MOORE, R. H. *Science*, **112**, 52 (1950).
21. NAYLOR, A. W., and DAVIS, E. A. *Bull. Torrey Botan. Club*, **78**, 73 (1951).
22. FREED, V. H. *Proc. Thirteenth Western Weed Control Conf.* (1952).
23. BLOUCH, R. M., and FULTS, J. L. In press.
24. FREED, V. H. *Weeds*, **1**, (1), 48 (1951).
25. FREED, V. H., and BIERMAN, H. E. *Oregon State Expt. Sta. Bull. 483* (1950).
26. BLOUCH, R. M., FULTS, J. L., and THORNTON, B. J. *Research Progr. Rept., Thirteenth Western Weed Control Conf.*, 22 (1952).
27. WILLARD, C. J., and PETERS, R. A. *Down to Earth*, **7**, (2), 10 (1951).
28. BOHMONT, D. W. *Wyoming Agr. Expt. Sta. Bull. 320* (1952).
29. SAMPSON, A. W., CHASE, A., and HEDRICK, D. W. *California Agr. Expt. Sta. Bull. 724* (1951).

A NEW INSTITUTE FOR A NEW BIOLOGICAL METHOD

NINE years ago a study was begun on the biological activity of blood outside the body. A technique has been developed for the tissue culture of blood and for observation of the response of its cells to infective and biochemical agents of disease. Significant differences between the blood in health and in disease have been noted. It is observed by vital staining that disease-producing agents may inhibit the respiration of, or destroy, both red and white blood cells.

The new study technique has been named the hemobiological method. Blood is a fluid tissue which normally is accessible to every cell in the body, as a common carrier of food and oxygen and the waste products of metabolism. Thus it logically may be expected to serve as an index to the immune status of the entire body.

Pioneer developmental work has been done by Elizabeth Willcox Kidwell, a microbiologist, who has been advised and assisted by scientists in many fields. Her research was based on studies in animal infection, especially Bang's disease in cattle, and on the work of Wright and other early immunologists on the defense mechanism of the body. During the past century, research on blood has been intensive, revealing much fundamental information concerning its chemical, physical, and immunochemical properties.

The Willcox Research Institute was incorporated on June 2, 1952, to permit study of the new method by scientists in many fields, well represented by the officers and directors of the new organization. The president of the Institute is J. Edward Spike, Jr., secretary of the Research Committee of the American Cancer Society; the vice president and medical director is Stanislaus H. Jaros, chief of the Allergy Medical Division, Grasslands Hospital, and associate medical director of Ayerst, McKenna & Harrison; the associate medical director is Daniel J. Feldman, of the staff of New York University Medical College and Bellevue and Goldwater Memorial hospitals; secretary-treasurer is Mrs. Kidwell. Other directors are Walter F. Willcox, professor emeritus of statistics, Cornell University, and honorary president of the International Statistical Institute; Roy M. Allen, consultant in microscopic sciences; John W. Butterworth, division engineer, Mackay Radio & Telegraph Co.; Clifton Read, publicist; and Wm. Curtis Pierce, member of the firm of Sullivan and Cromwell, attorneys.

The study has been accelerated by the development of a new technique for the preparation of microscopic wet slides by means of Deltaseal, a clear liquid plastic which hardens on drying, is nonabsorbent, noninflammable, and has little effect on blood. It is used to mark the slide with a rectangular chamber of the same dimensions as the

Blood damage in two cases of degenerative disease: Crystals of reduced hemoglobin produced by pancreatin in heparinized blood from a case of diabetes. (×16.5.) Effect of *Brucella* toxin on clot of a patient with rheumatoid arthritis; black clumps produced by the oxidation of the iron-bearing portion of hemoglobin. (×33.)

TABLE 1

PRINCIPAL CHARACTERISTICS OF BLOOD RESPONSE WHICH DISTINGUISH HEALTH FROM DISEASE

Phenomenon	Optimum Resistance	Maximum Effect on Disease
Leucocyte response to bacterial antigen or biochemical	Complete and immediate disappearance	Clumped, degenerated, killed, dissolved
Erythrocyte survival in same slide	Typical form of biconcave disk more or less intact—may remain unchanged for weeks	Degenerated or dissolved to an amorphous mass in a few hours or days
Hemoglobin reduced	Typical light-red color	Violet-red color
Crystals	None or at edge only	Massive, especially at center
Hemoglobin oxidized to methemoglobin	" " " " "	From rust color to deep-brown, part or all of slide
Oxidation of iron atoms in black clumps	None	May be profuse, especially in clot
Clot	Dissolves within a few hours, leaving trace of white film	Persists indefinitely, solid as a piece of tissue with crystals or oxidized clumps; polarizes light
Response to factors associated with hypersensitivity and tissue permeability	Immediate disappearance of leucocytes and lysis of clot	Damage to blood and clot
Response to antigens of *Staphylococcus, Streptococcus, Brucella,* and *E. coli*	Resistance to endotoxins; resistant or superficial crystallization by whole cells	Damage to blood and clot by whole cell and one or more endotoxins, often by all four organisms

cover slip. Slide, cover slip, and instruments are flamed, and the preparation is made under a sterile lamp. Whole, clotted blood is used, with a piece of clot crushed in the center of the chamber, which is then flooded with blood. A bacterial antigen or biochemical agent is added, and the cover slip is sealed in place with plastic. With air and contaminants excluded, the reaction may be observed to completion, possibly weeks later. A series of slides, each containing a separate test substance, may be used to evaluate the individual's resistance to a wide range of disease-producing agents.

If a drop of weak formaldehyde is added to a slide before the antigen is introduced, the blood is inactivated, and no significant damage occurs. The blood/antigen reaction appears to depend on the response of the leucocytes, as is true also when biochemicals are used. Thousands of studies on the blood of hospital donors showed that in bloods of the strongest resistance, every leucocyte disappeared immediately and completely, and the erythrocytes remained practically unharmed. In the blood of diseased individuals certain failures of this mechanism occur, followed by the appearance of various types of blood damage.

The criteria which distinguish health from disease appear to be relative, rather than absolute. All the bacterial and about 70 biochemical agents employed were found capable of producing damage in the blood of diseased animals and humans and the resistant response in the blood of those clinically well. Table 1 illustrates these comparative differences. Data collected from years of study in a variety of clinical states suggest that the disease complex may be associated with impaired blood response in vitro to many such substances. The crystallization of reduced hemoglobin, identified in the slides by spectrophotometer, appears to be associated with superficial inflammation or infection. In blood from patients with degenerative disease, known causative organisms, such as the tubercle bacillus, or biochemicals specific to the affected area produce damage mainly in the clot. All patients with a given syndrome appear to have certain factors of blood damage in common: pancreatin produces such damage in bloods from patients with diabetes or other pancreatic conditions; the digestive enzymes in peptic ulcer; the sex hormones in abortion and other gynecological disturbances. This is true also of substances that Jaros has shown to be associated with hypersensitivity and tissue permeability to which the bloods of the healthiest donors have been found resistant. Four organisms of chronic infection, *Staphylococcus, Streptococcus, Brucella,* and *Escherichia coli,* have been disrupted by ultra sound waves and their endoantigens separated by ultracentrifuge. Cases of chronic infection by each of these organisms have been found associated with blood damage

by one or more of the specific endotoxins.

Another type of blood damage not found in good health, but occurring frequently in advanced degenerative states, is due apparently to the oxidation of hemoglobin to methemoglobin and to clumps of black, roughly crystalline material. The latter has been identified by infrared spectrophotometry as an oxidation product of the iron-bearing portion of hemoglobin.

The relationship of various degrees of damage to the disease process in vivo requires much further study. A scoring method has been devised to show the individual's rating to each substance. Thus statistical data comparing responses in disease and health can now be obtained. The possibilities of the method for diagnostic study in various clinical fields will be investigated by the new institute. A grant has been received from the Victoria Foundation, which aided the developmental work.

Blood samples have been supplied by the Blood Transfusion Association of America, by St. Vincent's Hospital, by other hospitals, and by many physicians.

J. Edward Spike, Jr.

The Willcox Research Institute, Inc.
16 E. Ninth Street, New York 3

Example of damage to clot shown by effect of urea on blood from a case of cancer of the kidney. The structure of the clot is shown in contrast to the dark area of blood. One segment is completely crystallized. The upper portion shows a few crystals of reduced hemoglobin and the polarization of the fibrin of clot, which shows no evidence of crystallization, even under very high magnification. (Polarized light; × 11.5.)

SMO ON THE AIR

Station	Sponsor	Time
	Monday	
WOI-FM, Ames, Iowa	Iowa State College of Agriculture and Mechanic Arts (Articles of Interest)	7:45 P.M.
	Tuesday	
WEVD, New York City	Wendell W. Rázim (Science for the People)	9:00 P.M.
	Wednesday	
CKPC, Brantford, Ont.	The Telephone City Broadcast Limited (Modern Science)	9:45 P.M.
	(Irregular)	
KBER, Baker, Ore.	Baker-Union Department of Health (Research Report)	....

The Editor of The Scientific Monthly will be glad to cooperate with university or other educational stations interested in securing scientific material suitable for broadcasting.

BOOK REVIEWS

ORIGIN AND EVOLUTION OF CULTIVATED PLANTS

Plants, Man and Life. Edgar Anderson. 245 pp. $4.00. Little, Brown, Boston. 1952.

WRITTEN primarily as a popular book for the intelligent of the general public, *Plants, Man and Life* fulfils that aim in being both entertaining and absorbingly instructive reading for the nonprofessional in botanical fields of learning. In a very real sense, however, the true significance of the book can be appreciated to the fullest extent only by those with a wide scientific background. Books on science are seldom written in a style which creates the impression of personal contact with the writer, but to read *Plants, Man and Life* is like talking with the author. Edgar Anderson is a stimulating conversationalist; this is a stimulating book. Stimulation may, however, be superficial, whereas the theme of this book is thought-provoking. It is broad in scope, tolerant in principle, optimistic in outlook, and specific in pointing to important but neglected areas calling for cooperative research.

The subject is essentially the origin and evolution of cultivated plants. The keynote is that we know precious little about this subject, although new information is coming in at an accelerating rate from related fields, and it is high time that we work to develop ways and means specifically adapted to throw light on this important problem. It is important in an economic sense because an understanding of the history of cultivated plants would lead to more intelligent efforts to improve and utilize them. In a broader sense it is a contributing factor to the understanding of man, for man's cultural development is intimately tied up with his use of plant products. Furthermore, "A bringing together of men in different disciplines for the study of cultivated plants and weeds, an active co-operation of historians, anthropologists, and ethnobotanists would have as its important aim the advancement of understanding in that particular problem. Its greater ultimate effect would be the catalytic transfer of techniques and attitudes from one field to another."

Anderson begins his book by directing attention to man's transported landscapes. The plants that are closely associated with man are those that he has brought, intentionally or otherwise, along with him. The weedy camp followers and cultivated plants are, paradoxically, least known taxonomically, largely because their characteristics have been greatly altered and mixed by association with man. This gap is serious because to most of the scientific world the accurate classification of the plants closely associated with man is of more importance than that of all the other plants of the world put together.

Evidence from the fields of cytology and genetics has done much in recent years to clarify the origins of certain cultivated plants. The unraveling of the story of wheat is an excellent example of how cytogenetic studies have contributed to our understanding of the interplay between polyploidy, weedy relatives, and selection through long periods of time to produce a major crop plant.

There is a brief account of the tragedy of N. I. Vavilov, the great Russian botanist, who drew attention to the fact that the variability of cultivated plants is concentrated in a few relatively small geographic centers. The author suggests that these areas are points at which previously separated floras have come together and hybridized. It is often difficult to detect evidence of hybridization or, for that matter to distinguish ultimately a wild from a cultivated plant. Anderson explains how "pictorialized scatter diagrams" may be used as a tool to help clarify the composition and evolution of a population.

The history of cultivated plants is not only a problem in biology but quite as much one in archaeology, anthropology, nutrition, and other fields among which there is usually little communication. "At the present time, anthropologists and applied biologists are so far apart in their thinking that they seldom realize they have problems in common. Knowledge is all of one piece but universities (by tradition and for budgetary reasons) are divided into departments." Under these conditions a problem that cuts across department lines suffers in proportion to its interdepartmentalization.

Anderson's tribute to the late Professor Oakes Ames, of Harvard, who first aroused his interest in economic botany, is written with charm and provides some of the best popular reading in the book. Ames stressed the antiquity of agriculture and primitive man's uncanny ability to ferret out all known useful plant products.

The importance of the dump heap, a disturbed open habitat created by man, is emphasized throughout the book as a likely place for the origin of most cultivated plants. It is here that weedy plants congregate, thrive, and hybridize, bringing about a great diversity from which man could select the most promising types for his own use.

Plants, Man and Life ends with a chapter on the technique of "the inclusive herbarium," a means of bringing together in concise workable form the large amount of data needed to study adequately populations of cultivated plants. It is a clarion call to taxonomists to get busy and take their rightful place in this endeavor.

Finally, since there is an increasing tendency for scientific studies, including those on cultivated plants, to be relegated to "Our enormous government research labo-

ratories (which) tend to be staffed by able plodders who do not question well-established concepts"—then, "What the world needs if (this or any) science is to forge ahead is some kind of system which will allow the bold young men to try out their wild ideas in spite of the judgement of older and usually wiser men."

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THE WORLD AROUND US

Journey into Wonder. N. J. Berrill. xiv + 338 pp. $4.00. Dodd, Mead, New York. 1952.

Geography of Living Things. M. S. Anderson. ix + 202 pp. $2.75. Philosophical Library, New York. 1952.

THE common denominator of these two books is geography: man's relations with and knowledge of the planetary surface on which he lives. The Anderson volume is a straightforward, textbookish account of "biogeography," and the Berrill volume is an excursion into history, "the story of man's discovery of the natural world around us"—in the words of the subtitle.

Mr. Berrill is concerned mostly with the tropics, the poles, and the oceans, and he tells again the story of the great voyages that made the life of these regions a part of the subject matter of European knowledge. It is very hard to write freshly about the voyages of Columbus or about Darwin's experiences on the *Beagle,* but Berrill manages to keep the interest even of a hardened reader of natural history books. He does this by using the narratives of the voyages chiefly as a connecting thread on which to string bits of history of science, of his own philosophy, and of modern knowledge about the creatures encountered. Berrill is a man of wide interests and deep knowledge, who writes clearly, simply, and well; any book by such a man is bound to be a refreshing experience in reading, however hackneyed the subject.

The first five chapters are concerned with the voyages of Columbus. These are followed by an account of things seen by the Elizabethans, John Hawkins, Francis Drake, and Richard Hawkins. The middle portion of the book is taken up with the explorations of the oceans, using the travels of William Dampier and James Cook as background narrative. In the last section of the book, the tropics are viewed through the eyes of Alexander von Humboldt and Charles Darwin, and the Antarctic through those of the companions of Scott. The book ends with an excursion into geological history, built around the vicissitudes of the mammal faunas of the Americas.

I found myself most engrossed when Berrill was writing about the sea, where he could bring his own rich knowledge and experience to bear. I occasionally felt an impulse to lift my eyebrows when he got on land and into the tropical forest; but in such places he stuck pretty close to his sources.

The little book by M. S. Anderson belongs to a "Teach Yourself" series and has all the defects that seem to go with such eleemosynary intentions. If you brave the pedestrian and simple-minded prose, the content seems to be a good-enough account of some of the concepts of contemporary human geography, although I was often struck by what seemed to be a lack of awareness of the cultural elements of man's relations with nature. The book covers man as an animal; direct effects of environment on man; man, rocks, and water; man and his food; the soil; soil conservation; and pests and diseases.

I would like to ride a hobby by pointing out the complete absence of documentation in both books. It seems to me that Berrill might have added a section in the back of his book on available editions of the travels he so delightfully annotates. Surely this would in no way bother the general reader at whom he is aiming, and it might even lead such a reader on into further book exploration. Such an appendix, with indications of other sources, would be a great help to Berrill's fellow-naturalists. The absence of a reading guide from a teach-yourself book like that by Anderson seems to me to have no excuse whatever.

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THEORY AND PRACTICE IN HIGHWAY CURVES

Highway Curves. Howard Chapin Ives. (4th ed., rev. and including *Highway Surveying, Location, Geometric Design, and Earthwork,* by Philip Kissam.) xvii + 389 pp. Illus. $7.00. Wiley, New York; Chapman & Hall, London. 1952.

THE aim of the fourth edition of this popular book is the same as the first—to present the theory and practice of highway curves as followed in this country. In the more than twenty years since that first edition, however, many advances in highway design have been accomplished. The book therefore has been completely revised and the text rewritten to include selected methods for highway surveying, location, geometric design, and earthwork that, in the words of the preface, "simplify both the field operations and the mathematical solutions."

Part I outlines the principles of usually only one method each of handling simple, compound, reversed, vertical, and spiral curves. The method chosen for each is well discussed, and sufficient examples that outline the procedure to be followed are presented for each type of curve. The even degree and even radius methods of expressing curvature are explained in detail. Numerous formulas and definitions are found throughout the text, with illustrative figures and numerical examples.

The Searles spiral has been selected, and its ease of application to transition areas between tangents and circular curves is explained. All necessary tables for any length of spiral required and for any radius of curve with which it connects are given.

The chapters on earthwork present in a concise man-

ner the procedure for area computation of cross sections and the volume computations from these areas. The determination of haul and the construction and use of a mass diagram are discussed in detail.

Part I also includes a brief résumé of the principles of the preliminary and the location survey and the field procedure for making these surveys. The application of aerial photographs to the making of these surveys is briefly presented. Although the preface states that the principles of highway economics are outlined in the initial chapters, the space given to this important subject is negligible.

A concluding chapter on the computations and surveys necessary for highway interchanges is included, and a rather complete example of the necessary computations is given.

Part II is composed entirely of tables, trigonometric formulas, and an explanation of the tables. These include tables of logarithms, natural trigonometric functions, squares and cubes of numbers, and common conversion tables and useful numbers. Many of these tables have been taken from the previous editions of this book. New tables in this edition make it unnecessary to use logarithms or a calculating machine to compute the values for a simple curve. The necessary tables for curves of even radius, curves of even degree, and Searles spiral are presented in clear, compact form. The explanation of all tables is also clear, and each is well illustrated with examples. Ten pages of definitions and mathematical formulas and identities are included at the end of Part II.

This highway engineering book is designed strictly for engineers. It is handsomely bound and conveniently sized to serve as an excellent reference volume for the selection of fast, precise field and computational methods and the tabular information needed for the office and field handling of highway curves.

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ATMOSPHERIC DISCUSSION

Across the Space Frontier. Wernher von Braun *et al.* Cornelius Ryan, Ed. xiv + 147 pp. Illus. $3.95. Viking, New York. 1952.

ONE'S first reaction on seeing a book with this title is almost always "Another of those scientifictive books which mix a little bit of science and a large amount of nonsense with an enormous fantasy." However, when one sees that scientists such as Whipple and Kaplan are among the co-authors, second thoughts begin to enter one's mind, and when one finally settles down to read, it turns out that this volume—an expanded version of a symposium organized by *Collier's*—presents a serious and scientific attempt to give a program for future developments in man's ever-growing want to reach beyond his present confines.

Von Braun, one of the world's foremost experts in rocket research, describes how it might be possible to establish in a satellite orbit 1075 miles above the earth surface a "space station;" that is, a man-made satellite from which flights to the moon or other planets might take place, but which first of all would serve as an observation post both for astronomical purposes and for controlling man's activity on the earth. One can hardly help but feel that Von Braun's statement that the establishment of this "space station" might take place within ten to fifteen years, provided the necessary money (4 billion dollars!) were available, could well be true.

Haber, who until recently was with the U. S. Air Force's Department of Space Medicine, discusses in great detail whether human beings could survive either the journey to the space station or living on (or, better, in) this man-made satellite. This chapter was to me the most fascinating of all the contributions and showed to my mind clearly that even if survival were possible (and the odds seem to be in favor of it), the hazards are great and meteors seem to be an ever-present danger.

Other contributions to this fascinating book are a lucid chapter by Kaplan on our atmosphere, a discussion of the space station by Ley, a discussion of the legal aspects by Schachter, and a discussion of the value of an astronomical observatory outside our atmosphere by Whipple. The only weak spot is the introduction by Ryan, the editor, which is written in true journalistic style without sufficient scientific restriction, and it is just the scientific approach in most of the discussions which makes this book such interesting and fascinating reading.

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THE HIGHER LEARNING IN CALIFORNIA

General Education in Action. B. Lamar Johnson. xxvi + 409 pp. $4.00. American Council on Education, Washington, D. C. 1952.

EDUCATION, as a professional discipline, is the target for much harsh and severe criticism at the hands of those who feel it is wallowing around, expending great effort but accomplishing very little. However illogical and poorly thought-out much of the attack is, it does represent real dissatisfaction with manifest weaknesses and excesses with which education can rightly be charged. Perhaps the most important of these criticisms are presented in Robert M. Hutchins' *The Higher Learning in America,* in which he has given expression to a wide range of dissatisfaction with American education. Many of his specific charges are well taken: the confusion as to the purposes of higher education, the function of the high school—a function which has yet to be clearly defined, the cafeteria offerings of universities the curricula of which are built upon popular demand, the fractionization of the college curriculum into isolated subjects. His charge that the

university has spawned a sort of anti-intellectualism is a telling indictment of what goes on behind the ivied walls of many a college and university building.

Dr. Hutchins' indictment against current evils in higher learning is competently thought out, and some of his proposals for remedying the defects are worth the most serious examination and study. In his recommendation that education ground itself in "metaphysics" Hutchins brings his study to a grinding halt. He disavows any desire to delineate the kind of metaphysics he beckons us to follow. Like Erasmus, Hutchins is direct, forceful, and specific in criticism, but is unable to follow through in terms of definable, workable solutions. Perhaps it is enough that a critic should lay bare the weaknesses of our educational theory and practice and leave to others the task of construction and synthesis. Herein lies the value of the volume under review, *General Education in Action,* a book of genuine accomplishment and hope.

If, as Hutchins alleges, the higher learning is marked by confusion, the confusion is perhaps the turmoil that inevitably accompanies experiment and the testing of promising educational concepts and techniques, rather than the bewilderment that signifies loss of direction and purpose. Like our nationwide experiment in democracy, we have been at the business of education a comparatively short time and we have much to learn. Nevertheless, we do have some achievements in which we may well take great pride, the most notable being our vast system of public schools at all levels. To keep its theoretical structure and classroom practice maximally productive, and genuinely conducive to democratic action on the part of millions of students, is an enormously complex task. Mistakes will be many and singular achievements few, albeit notable. *General Education in Action* brings together the findings of the California Study of General Education in the Junior College. Although repetitive and sometimes bogged down by obscure educational terminology, the report is an exciting statement of the role and promise of junior colleges in the California region. As President Conant of Harvard has indicated on numerous occasions, the extension of the junior college movement into one of nationwide proportions may be a workable answer to the problem of higher education for many of our young citizens. The California study lends convincing support to a thesis Dr. Conant has espoused for some time.

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BRIEFLY REVIEWED

Mount McKinley and the Alaska Range in Literature: A Descriptive Bibliography. Bradford Washburn. 88 pp. Museum of Science, Boston. 1951.

THIS bibliography is the first attempt to gather together a list of the literature on, and interesting references to, Mount McKinley and the Alaska Range. It is doubtful whether completeness has been achieved in this initial endeavor. The majority of titles listed date from the period following the acquisition of Alaska by the United States. There are nine references from the era of Russian domination, but only three by Russians. It seems probable that others exist, though perhaps they are not available. A large number of articles concerning Mount McKinley and contiguous areas is included. The unique position of Mount McKinley, as the highest mountain in North America, accounts for the predominance of titles concerned with exploration and mountain climbing. The struggle to reach the summit and Dr. Cook's claim to success provide numerous papers. Bradford Washburn's concise descriptions of the references concerned illuminate and clarify the accomplishments in this region. Other portions of the Alaska Range, notably the section traversed by the Richardson Highway, are less thoroughly covered than the McKinley region. For example, the articles concerning the rapid advance of Black Rapids glacier in 1936 are not included.

The bibliography contains 264 entries arranged alphabetically: 200 titles are listed by author; 64 by the name of the newspaper or periodical. The lack of classification is a feature that can be condoned only by the brevity of the bibliography. The separation of the listings into two parts—one devoted to articles by known authors, the second, to accounts in newspapers and periodicals—would in large part segregate primary from secondary sources and thus add to the usefulness of the bibliography.

Aside from the above criticisms, Bradford Washburn is to be congratulated for compiling a surprisingly long list of articles on Mount McKinley and the Alaska Range. His descriptive notes are never monotonous; not only do they depict the contribution each entry added to the knowledge of the area, but they also make the complete perusal of the bibliography an interesting summary of the history of exploration in the Mount McKinley–Alaska Range.

ELIZABETH W. OLMSTED

Lewiston, New York

An Essay on Method. C. Hillis Kaiser. vi + 163 pp. $3.25. Rutgers University Press, New Brunswick, N. J. 1952.

THE purpose of this monograph by a professor of philosophy at Rutgers University is twofold: first, to approach human culture objectively with the aim of classifying and describing its principal "nobler" activities and their differences; and, second, to point out defects in our present system of education and suggest changes which it is hoped would better produce leaders of ability in all fields.

To achieve the former, activities are divided into four exclusive categories: artistic, scientific, philosophic, and religious. In order to discuss their similarities and distinctions, these are further classified with respect to certain qualities. Thus, the author regards artistic and

scientific activities as being playful (done for pleasure) and immediate (concerned with sensed things), whereas philosophic and religious activities are serious and transcendental. On the other hand, philosophy and science both endeavor to draw conclusions, whereas religion and art do not, the former aiming at the achievement of the attitude of conversion, and the latter of aesthetic appreciation. The remainder of the book is largely devoted to the explanation and justification of these distinctions. To illustrate this approach, art, in Professor Kaiser's definition, refers not to the created thing, but the act of creation, and is not self-expression but self-amusement. Science is not a body of facts but of *acts* of discovery. More controversial, perhaps, is his definition of philosophy, for here he requires that its objective be the search for premises underlying the relationship of man and the world which shall be *necessary*, rather than merely possible. In his approach to religion he accepts the necessity of mysticism, and draws a clear distinction between religion and social humanitarianism.

In discussing the role of education in our society, he condemns what is only technical. The extreme progessive school he sees as a system in which the educated are taught by the uneducated, and condemns its use beyond the nursery school as leading to adult infantilism. To quote (p. 160):

"Our formal education, if it is to fulfill this ideal, should not merely tell our students about religion, or religions; it should make them religious. It should not merely portray the range of philosophical positions, historical and theoretical; it should encourage them to *take* a position. It should not merely acquaint them with art products and the history of art; it should make them into artists. It should not merely provide them with scientific information or technological training; it should make them learn to do science."

As a program of education for the "uncommon man," it has merit.

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Fundamentals of Engineering Electronics. (2nd ed.) William G. Dow. 627 pp. $8.50. Wiley, New York. 1952.

FOR those who are familiar with the first edition (dated 1937) it will suffice to remark that changes in the new edition comprise the adoption of rationalized M-K-S units throughout, some rearrangement and revision of subject matter, the inclusion of devices such as the Cavity magnetron, klystron, traveling wave amplifier, and passing mention to crystal rectifiers and transistors.

Professor Dow's text is indeed a useful contribution to the field of electrical engineering. It is designed to impart an understanding of the physical principles underlying the operation of those nonpassive circuit elements that are the core electronic circuits. In order to accomplish this aim, the following subjects are treated: kinetic theory of gases, gaseous conduction, electromagnetic theory (including electron ballistics), quantum theory, electron theory of metals, and semiconductors. In keeping with the objective of the text, only about 15 per cent of the space is devoted to circuitry and applications. The author probably feels that such matters are given ample emphasis elsewhere in the literature.

It is interesting to compare this text and its title with *Electronics*, by Elmore and Sanders. Although the titles are similar, there is virtually no overlap in subject matter. This in itself is evidence of the remarkable growth of electronics in the past decade.

B. Gossich

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Between Pacific Tides. Edward F. Ricketts and Jack Calvin. Third edition, by Joel W. Hedgpeth. xiii + 502 pp. Illus. $6.00. Stanford University Press, Stanford, Calif. 1952.

AMERICAN students of marine biology are familiar with the earlier editions of this classic presentation of the littoral fauna of our Pacific coast. Joel Hedgpeth's new edition is a great improvement over the earlier publication and will certainly become a favorite on the laboratory tables at marine stations.

Hedgpeth has made two important contributions, one being a splendid chapter on Intertidal Zonation, the other a much improved and expanded appendix. The latter is an annotated systematic index and bibliography to which have been added numerous species, new sections covering intertidal insects and the marine mammals, and countless, carefully selected references. Adding to the beauty and usefulness of the book are a number of new photographs by Woody Williams, and several dozen new drawings, including 24 excellent cuts from Gilbert M. Smith's Monterey algae work. Throughout the body of the reprinted text, specialists have made all necessary changes in nomenclature. Hedgpeth has not only given the book more scientific backbone, but has also made his additions in a pleasing style and, at times, with tangy humor. It is a wonder, for instance, that his remarks near the top of page 475 and on the middle of page 473 escaped the "dollared" eyes of the American Printers' Union.

The publishers are to be commended on two other improvements. First is their courage in making this more compact edition a full inch less in thickness, despite the addition of 138 pages. The thinner, but superior, paper lends itself better to the line drawings. Second, they have reduced the useless 15 pages of "List of Illustrations" to a neat, single page. More houses should follow suit in eliminating these old-fashioned, publisher's "vanity pages," which only annoy the reader and the space-limited author.

R. Tucker Abbott

U. S. National Museum
Washington, D. C.

Roger Bacon and his Search for a Universal Science. Stewart C. Easton. viii + 255 pp. $4.00. Columbia University Press, New York. 1952.

THIS biography is the work of a critical historian who makes his sources and his method explicit. The critical attitude is indispensable in the study of Bacon because of the mass of legend that attributes to him breath-taking anticipations of modern inventions.

Bacon regarded science as having been handed down in an esoteric succession from Seth, a son of Adam, through the Hebrew patriarchs, the Egyptians, and the Chaldeans, to Aristotle; thence, through the Arabian commentators, to Bacon himself.

Another phase of Bacon's thought that will seem strange to us is that he regarded moral purity as a necessity for scientific research. The redemption of man, moreover, opened the cognitive faculties to a degree never enjoyed by the pagans.

Easton has little interest in Bacon's apparent anticipations of modern knowledge. Indeed, from the disciplines he lists as Bacon's concern—among which astrology and alchemy play a large part—one gets the impression that Bacon's modernity has been overrated. The *Doctor mirabilis* did, however, appreciate *scientia experimentalis.* Easton carefully translates this as "science of experience" rather than "experimental science," in order not to make Bacon appear to anticipate his later namesake.

Bacon left some thoughts that remain valuable. His idea that science has its ultimate usefulness in bringing man to Christ is obsolete, but the generality that social salvation is to be expected of the scientific enterprise is worth remembering. His perception of the interrelatedness of the sciences, the organic whole of knowledge, was a vision of which the twentieth century might well be reminded.

RUFUS SUTER

Army Map Service
Washington, D. C.

Science and Hypothesis. Henri Poincaré. xxvii + 244 pp. $1.25, paper-bound; $2.50, cloth-bound. Dover, New York. 1952.

Science and Method. Henri Poincaré. 288 pp. $1.25, paper-bound; 2.50, cloth-bound. Dover, New York. 1952.

ORIGINALLY written in 1903 and 1908, these commentaries on the nature of physical theories have an interest that is now chiefly historical. However, almost a half of the earlier work is devoted to the relationship of pure mathematics and the world, and this portion is still the final word on this question. The second volume contains the often-quoted biographical episode in which Poincaré analyzes the processes of mind which led to some of his own discoveries. Both books come in Dover's inexpensive paper-bound series.

R. C. BUCK

Department of Mathematics
University of Wisconsin

NEW BOOKS

The Elements of Nuclear Reactor Theory. Samuel Glasstone and Milton C. Edlund. vii + 416 pp. Illus. $4.80. Van Nostrand, New York. 1952.

Quantitative Analysis. Harper's Chemistry Series. William Marshall MacNevin and Thomas Richard Sweet. ix + 247 pp. Illus. $3.75. Harper, New York. 1952.

Industrial High Vacuum. J. R. Davy. viii + 243 pp. Illus. $5.50. Pitman, New York. 1951.

Organic Chemistry: The Chemistry of the Compounds of Carbon. (2nd ed.) Lucius Junius Desha. xvi + 595 pp. Illus. $6.50. McGraw-Hill, New York. 1952.

Archeology of Eastern United States. James B. Griffin, Ed. x + 392 pp. Illus. $10.00. University of Chicago Press, Chicago. 1952.

Calculus, A Modern Approach. Karl Menger. xxv + 253 pp. Illus. Mimeo. $4.50 + 35¢ postage. Institute of Technology, The Bookstore, Chicago. 1952.

Histoire Géologique de la Biosphère. H. Termier and G. Termier. 721 pp. Illus. Paper-bound, 8600 Fr. fr; cloth-bound, 9200 Fr. fr. Masson & Cie, Paris. 1952.

The Nile. H. E. Hurst. xv + 326 pp. Illus. $6.00. Macmillan, New York. (Printed in Great Britain). 1952.

Rocks for Chemists. An Introduction to Petrology for Chemists and Students of Chemistry. S. J. Shand. xii + 146 pp. + 32 plates. $4.50. Pitman, New York. (Printed in Great Britain). 1952.

Rockets Beyond the Earth. Martin Caidin. 304 pp. Illus. $4.50. McBride, New York. 1952.

Psychoanalysis as Science. The Hixon Lectures on the Scientific Status of Psychoanalysis. E. Pumpian-Mindlin, Ed. x + 174 pp. $4.25. Stanford University Press, Stanford, Calif. 1952.

Origins of American Scientists. A Study Made under the Direction of a Committee of the Faculty of Wesleyan University, Middletown, Conn. R. H. Knapp and H. B. Goodrich. xiv + 450 pp. $7.50. University of Chicago Press, Chicago. 1952.

Student Deferment in Selective Service. M. H. Trytten. viii + 140 pp. $3.00. University of Minnesota Press, Minneapolis. 1952.

Grafología y Grafotecnia. Alberto Posada Angel. xvi + 444 pp. Illus. Editorial Bedout, Medellin, Colombia. 1952.

The New Dictionary of American History. Michael Martin and Leonard Gelber. vi + 695 pp. $10.00. Philosophical Library, New York. 1952.

Automation. The Advent of the Automatic Factory. John Diebold. ix + 181 pp. $3.00. Van Nostrand, New York. 1952.

Associated Measurements. M. H. Quenouille. x + 242 pp. Illus. $5.80. Academic Press, New York. 1952.

The Methods of Statistics. (4th ed.) L. H. C. Tippett. 381 pp. Illus. $6.00. Wiley, New York. 1952.

The Medieval Science of Weights. Treatises Ascribed to Euclid, Archimedes, Thabit ibn Qurra, Jordanus de Nemore, and Blasius of Parma. Ernest A. Moody and Marshall Clagett, Eds. x + 438 pp. $5.00. University of Wisconsin Press, Madison. 1952.

Introduction to the Foundations of Mathematics. Raymond L. Wilder. xiv + 305 pp. $5.75. Wiley, New York. 1952.

Physical Chemistry. (3rd ed.) Frank H. MacDougall. xi + 750 pp. $6.00. Macmillan, New York. 1952.

Diffusion in Solids, Liquids, Gases. W. Jost. xi + 558 pp. $12.00. Academic Press, New York. 1952.

LETTERS

DOCUMENTING THE SCHUSS-YUCCA

I AM delighted that at long last you have printed the results of an investigation that will vindicate the late Dr. Grünspann. Although a complete set of the *Handbuch der Yucca* is not available to me, I recall that nowhere in the portions I've seen has Dr. Grünspann clearly indicated why the Schuss-yucca grows so fast. Therefore the following observation, although not quite firsthand, surely should be included in the forthcoming third edition of the *Handbuch*.

My grandfather, in his youth, knew the yucca country very well. He was engaged in the freighting business, holding what would now be called a "cost-plus contract" as a freighting contractor to the government. The distances were so great, he often told me, that he was forced to sublet much of the mileage to other owners of mule-drawn equipment. But a portion he reserved for himself and personally operated his mule trains over that stretch. The reason for this, he explained, lay in the soil. He discovered, quite by accident, that in the yucca country the mule shoes seemed never to wear out; at no time had he ever seen this particular stretch of the long route too wet for good mule footing or so dry as to be dusty. He also insisted that he had never lost an animal on his route. They simply did not die in the Schuss-yucca country, although such losses were very troublesome throughout the West. After several of his mule trains had been operating there he discovered that he had to remove the shoes, since they had become too heavy through accretions of what appeared to be ordinary shoe metal. In self-defense he began to trade mule shoes with contractors; he sold them the "new" heavy shoes worn by his teams, taking in exchange the frayed and worn shoes of his competitors. He was thus able to amass a great fortune on which, of course, no income tax had to be paid. His stories of the Schuss-yucca so closely paralleled the amazing evidence presented by Dr. Albrecht and Professor Grünspann that for many years the family ruled that they were not to be repeated to strangers. Although Grünspann traveled by burro, my grandfather has shown me old records indicating that he personally freighted much of the material for the Grünspann Expedition, pointing out that the most difficult job was keeping the bottles tightly corked!

Grandfather knew nothing of soils and made no attempt to explain his experiences, but a résumé of some recent work, superbly detailed in the *Cornell Vegetable-Crop News*, seemingly holds the key to the strange behavior so carefully documented by Dr. Albrecht and Professor Grünspann. In this paper there is a description of a new material—a soil conditioner so selective as to be called magical—so concentrated that a pound weighs just 16 ounces. This material "ERUNAM" apparently underlies the entire Schuss-yucca range. In fact, from the somewhat meager evidence now available, the whole Schuss-yucca area might be considered a solid deposit of ERUNAM.

I trust every effort will be made to hasten the compilation of the new material so that the third edition of the *Handbuch* will not be needlessly delayed.

AUGUST P. BEILMANN, *Manager*
Missouri Botanical Garden
St. Louis

AN ARTICLE that appeared in the October 1952 edition of THE SCIENTIFIC MONTHLY, entitled "The Schuss-Yucca," is of particular interest to us in Pasadena because the scene of this remarkable plant's activity (the yucca is one of the few vegetables that may be said to engage in activity) is in this city's backyard.

I therefore would like to do a feature story on the Schuss-yucca, but I don't want to wait until the growing season next spring. I'd like to request that you lend this paper prints of the photographs used in your article, and that you be kind enough to give us permission to quote from your article. Credit will be given, of course, on all material used.

You may be interested in hearing of one case of carelessness in regard to the Schuss-yucca that cost a man a promising career. A rising young pugilist, the man liked to hike as an adjunct to the endurance-building roadwork he did. Once he stopped hiking long enough to inspect a yucca at just the wrong time. Suddenly it shot up 16 or 17 feet, dealing him a terrific blow as the top of the stem caught him under the chin. Then and there he gave up the prize ring in favor of a career as a cordwainer's assistant. All he would say of the unfortunate incident was, "Any time a goddam bush can lay me out cold, I know pricefighting [*sic*] ain't for me."

E. E. SLOMAN

The Independent
Pasadena, California

THE note by Dr. Albrecht on the Schuss-yucca has just come to my attention. I cannot locate Taft College* in place or function, and therefore cannot write the author directly. Your correspondent has incorrectly placed the portion of Chilao Flat† which is the principal habitat of the plant in question. I can, however, offer partial corroboration of his observations. Several years ago my interest was aroused by the Grünspann report which he cites and I immediately repaired to

* I assume the function is not electoral and I conjecture the location to be in or near Burlington.

† This is not in the San Gabriel Mountains, but in the San Luciferos, a range that leads in quite a different direction.

Chilao Flat with my trusty Brownie‡ and several rolls of film, with the idea of making not merely time-lapse exposures, but a movie in which there should be no hint of such fakery as has made the name of Disney opprobrious in scientific circles.

A suitable prebloom specimen of the Schuss-yucca was soon located; the camera was set up, and exposures proceeded to a stage midway between Dr. Albrecht's first two figures. Unfortunately the deer§ that guided me was accompanied by a swarm of blue-tailed deer flies.‖ Just at this point one of these insects impinged upon the upthrusting apex of the Schuss-yucca. The violence of the resulting detonation obliterated the Schuss-yucca, the camera, and my own memory of the incident until the latter was just now recalled by Dr. Albrecht's paper. I trust, however, that these fragmentary observations may serve to dispel skepticism such as some of my colleagues here have expressed concerning Dr. Albrecht's investigations.

Dr. Albrecht's mention of unusually potent rattlesnakes in the Chilao region suggests further possibilities for a versatile camera. In certain wooded areas of Michigan, there occurs a mutation of the common garter snake (*Thamnophis sirtalis michiganensis hyperbola-faciens*) vulgarly known as the hoopsnake. This mutation is said to have originated from a primordial garter snake that fell from its original habitat on some aboriginal limb, and landed on its head.¶ Reports of a hoop-mutation of the Chilao sidewinder have been rife among the primitive peoples of Chilao but—to my knowledge—have never been scientifically confirmed. I recommend the problem to Dr. Albrecht's attention, but would suggest that ordinary brands of antivenin may not protect against the hazards of such research.

One detail of Dr. Albrecht's photographs bothers me. Examined with one of the newer phase microscopes equipped with 10 IQ ocular and Schlitz psychosomatic amber objective of n.a. .0025, the face of the lovely model shows greater aging between exposure 1 and exposure 5 than the cited time lapse would seem to account for. However, any doubt I may have first felt in the matter has been allayed by Dr. Albrecht's last, or escape clause, sentence.

E. E. Stanford

Department of Botany
College of the Pacific

‡ As I had in mind purely scientific observations, no fascinating model and no antivenin were included.

§ One of the quadrupedal kind, *Odocoileus hemionus californicus californicus longifrons*.

‖ The velocity of this insect was established some years ago, after some scientific controversy, as approximately 600 miles per hour. (Or it may have been per minute or per second; some chemist borrowed my copy of the paper and I cannot cite it exactly.)

¶ This sounds like pure Lysenkoism but is vouched for by any number—*any* number—of Nordic Michiganders who have never been suspected of subversive leanings.

On pages 250–52 of the October issue is found a glaring example of what can happen in decadent capitalistic countries where uncontrolled plant growth is tolerated. Such an outrageous phenomena is never occurring in our glorious laboratories where we have benefit of thought-control of that greatest of horticulturists, our magnificent leader.

I. Tinkeyiss Offenzieknutz, *Director*
Institute for Socio-Economic
Horticultural Orientation, Splonsk

To confute the skeptics still existing among the readers of The Scientific Monthly, I now release the terrible sixth photograph, which I had withheld out of deference to the American tradition of the happy ending.

The Schuss-yucca, a moment before in full and radiant bloom, suddenly withered, the blossoms turned to seed pods, and the yucca moths (*Pronuba maculata*, var. *Schuss*), which live with the yucca plant in mutualism (a type of sinful relationship between plants and animals), fell like snow, their wings and other parts singed by their rapid flight and other life processes at Mach 2! (See Grünspann, *Handbuch der Yucca*, Vol. 13, pp. 606–909. This section is devoted to the remarkable adaptation of the ordinary yucca moth to the exacting needs of the Schuss-yucca.)

It was only a moment before that the model, ecstatic with surprise and wonder at the beauty of the Schuss-yucca, had whispered sweetly some words of amaze-

ment ("I'll be damned!"). When the terrible transformation to a withered stalk ensued, she wrung her hands in anguish and, muttering incoherently some lines from a dreary poet,* fell in a heap among the dead yucca moths, and had to be revived with two jiggers of antivenin. She has been morose ever since and has taken up spiritualism.

Picayunish photographers and engineers who have incorrectly interpreted the shadows will doubtless be relieved to see them back in place in the accompanying photograph.

GUSTAV ALBRECHT

Department of Chemistry, Taft College

* No more, no more, no more,
Shall bloom the thunder-blasted tree
Nor the stricken eagle soar.
—EDGAR ALLEN POE

I WAS delighted at the hoax perpetrated by the article on the Schuss-yucca in the October issue of your journal; I was so completely taken in that I sent the article to the Royal Horticultural Society, who have now enlightened me.

I am told that after very careful examination no trace has been found of Professor Grünspann or of his book; further, the translation of the publishers' name, Schmutzig-Verlag, tends to confirm that the whole affair is a hoax.

You may also be amused to learn that this article was referred to, in all seriousness, by the Science Reporter of one of our leading national Sunday newspapers.

G. H. BEAZLEY

Nobel House
London, England

HITS AND MISSES

"Psychobiological Periodic Table of the Elements," published June 1952 in THE SCIENTIFIC MONTHLY, ignores all the disciplines of science. Its style is smug, and its content, either trivial or nonsense. This attempt to create a monster, compounded of science and metaphysics, loses itself in a pathetic morass of numerology.

It is possible the article appeared under "Science on the March" because it was thought to be suggestive of a hyperscientific approach to reality, that it hinted at some unifying theory which would include science along with the Atman, Brahma, and Nirvana.

Unfortunately, this is not the case, nor could it possibly be, in view of the author's superficial knowledge of chemistry and ignorance of the bare fundamentals of both physics and mathematics. As it stands, the article is sheer effrontery to honest workers in the field of science.

WM. BRADLEY LEWIS

Idaho Falls, Idaho

I AM taking this opportunity to congratulate you on the excellence of the August issue of your magazine. "Aimlessness in Education" is worthy of particular mention. You people are rendering an excellent service to humanity and the nation. Keep up the good work.

PAUL H. BELDING

Dental Items of Interest
Publishing Company Incorporated
Waucoma, Iowa

SINCE I have been a member of AAAS for some time, and receive THE SCIENTIFIC MONTHLY, I am taking time to comment on your August issue. For many months it was noticed that AAAS was loaded with chemistry, physics, and practice of medicine in its publications, and now it is indeed refreshing to see other sciences appear—especially comments from overseas institutions and professional writers who have something to say, other than having a paper appear in print. This "extrovert" reading in the August issue is imparting knowledge to people who no doubt are getting a new slant on AAAS publications. Since the AAAS is a sounding board for American science, I hope future issues will contain more such material. The articles on statistical administration and engineering progress and the book reviews by Mr. Flesch were about the best in editorial selection I've seen since being with the AAAS.

JOHN A. CASEY

Hempstead, Long Island, New York

I ENJOYED Bestor's "Aimlessness in Education." It was a powerful article and a perfect illustration of the disagreement of reason. Both sides of this controversy are partly right and partly wrong. We need this sort of discussion to bring out the truth. The old classical pedagogues needed a bump to stir them from their fixation on discipline for discipline's sake alone. The modern educators need restraining lest they sugar-coat discipline with immediate utility to such an extent that no lasting qualities remain. Your policy of presenting both sides is commendable.

H. H. SLOSS

Vredenburgh, Alabama

I HAVE read the item "Lost a Cow?" which appeared on page iv of the November 1952 issue of THE SCIENTIFIC MONTHLY, and I would like to call your attention to a statement which would indicate that you received erroneous information concerning this subject.

With regard to the statement that FBI fingerprint experts are cooperating with researchers at the South Dakota Agricultural Experiment Station, I thought you might like to know that this Bureau is not engaged in any research or other project in connection with cattle identification.

For your information, I have seen previous articles relating to this, and the individuals described as FBI fingerprint experts have been determined to be employees of the Office of the Attorney General of South Dakota. They have never been employed by this Bureau.

J. EDGAR HOOVER

Federal Bureau of Investigation

YOU MIGHT AS WELL NOT BELIEVE IN FAIRIES

FENTON B. TURCK'S article in your September issue, entitled "The Great American Explosion," affected me in much the same way that marijuana does its addicts—gravitation lost its pull and the pearly gates were opened wide. Then as I came to I began to ask myself whether the "explosion" the author describes has yet occurred or is merely in the process of making. He seems to feel that in some esoteric way we have been cashing in on our assets. This gives one a comfortable sensation, like that of being told that instead of reclining on a time fuse terminating in a charge of TNT he is resting on a bed of roses.

Here's hoping Mr. Turck may be right. But the skeptic will still inquire whether we have been cashing in on the assets or merely pledging them. If the latter—and an ever-growing astronomical national debt strongly urges that it is—then The Great American Explosion is still in the offing and is certain to be a very different one from the kind he describes.

Can it be that the savants responsible for screening contributions to THE SCIENTIFIC MONTHLY really do believe in Santa Claus? If so, the further query arises as to whether I can afford to continue my subscription.

THOMAS R. REED

Atlanta, Georgia

IN READING the most interesting article by Mr. Turck in "Science on the March," in the September 1952 issue, the thought occurred that the distribution here in Northern Bavaria of a translation of the article would serve very effectively to counter the constant and insidious Communist propaganda that America is a cultureless land.

I do not know whether your policy would permit the reproduction of a translation of such an article for local distribution but do feel strongly that it would be a useful adjunct to our efforts to establish a working cultural relationship and sympathy between Bavaria and our own country. We would indeed be grateful if you were to find it possible to permit us to undertake such a translated distribution.

May I add that THE SCIENTIFIC MONTHLY is regularly received by each our seventeen Information Centers (Amerika Haeuser) in Bavaria and wears out quickly because of the demand for it among English-speaking German visitors.

LOWELL BENNETT

Nuernberg Regional Center
Munich Consular District

I read the editorial in the New York *Times* based on your article "American Explosion" and I was most impressed. That is just the kind of material that is hard to find, but infinitely useful in creating a true understanding in Europe and Latin America about the United States. . . . If reprints are made, please let me know, as I would like to send some to France and South America.

EDWARD LAROCQUE TINKER

New York

RENDER UNTO CAESAR

THE cover photograph used on your November issue was incorrectly attributed to me. Both it and the other shot showing the tank aboard the *Atlantis* were made by Don Fay for Lamont. I should be happy to have made these exposures, but since I did not I feel that Mr. Fay has been unjustly treated. The error seems to have arisen with us.

RICHARD E. HENINGHAM

Lamont Geological Observatory
Columbia University

ASSOCIATION AFFAIRS

AAAS GENERAL OFFICERS—1953

ON JANUARY 15, the officers elected at the meeting of the AAAS Council in St. Louis on December 27 assumed their responsibilities for 1953. At the same Council meeting a revised constitution and new bylaws were adopted, and they will become effective January 27. On that date the Executive Committee will be transformed into the Board of Directors, which will consist of the three presidents and eight elected members as named below, plus the Administrative Secretary and Treasurer as ex officio members without vote.

The retirement of Kirtley F. Mather makes Fernandus Payne senior member of the board in length of service (elected 1946). Mark H. Ingraham and Paul E. Klopsteg were re-elected for regular four-year terms, and Wallace R. Brode was elected to complete the unexpired term of Warren Weaver, now president-elect. Among the vice presidents, Clarence E. Davies was chosen to serve a second term as chairman of the Section on Engineering. The complete roster of general officers for 1953 follows:

President: E. U. Condon, Corning Glass Works

President-elect: Warren Weaver, Rockefeller Foundation

Retiring President: Detlev W. Bronk, The Johns Hopkins University

Vice Presidents and Chairmen of Sections:

Mathematics (A): Tibor Rado, The Ohio State University

Physics (B): George R. Harrison, MIT

Chemistry (C): Randolph T. Major, Merck & Co., Inc.

Astronomy (D): Bart J. Bok, Harvard College Observatory

Geology and Geography (E): Wilmot H. Bradley, U.S. Geological Survey

Zoological Sciences (F): Paul Weiss, University of Chicago

Botanical Sciences (G): Edgar Anderson, Missouri Botanical Garden

Anthropology (H): James B. Griffin, University of Michigan

Psychology (I): Frank A. Beach, Yale University

Social and Economic Sciences (K): Lowry Nelson, University of Minnesota

History and Philosophy of Science (L): Richard H. Shryock, The Johns Hopkins University

Engineering (M): Clarence E. Davies, ASME

Medical Sciences (N): Cornelius P. Rhoades, Memorial Center for Cancer Research

Agriculture (O): K. S. Quisenberry, U.S. Department of Agriculture (Beltsville)

Industrial Science (P): Francis J. Curtis, Monsanto Chemical Co., St. Louis

Education (Q): Donald D. Durrell, Boston University

Members of the Board of Directors

Detlev W. Bronk (*Chairman*), The Johns Hopkins University

Wallace R. Brode, National Bureau of Standards (1953)

E. U. Condon, Corning Glass Works (1952–54)

John R. Dunning, Columbia University (1952–55)

Walter S. Hunter, Brown University (1951–54)

Mark H. Ingraham, University of Wisconsin (1953–56)

Paul E. Klopsteg, National Science Foundation (1953–56)

Fernandus Payne, National Science Foundation (1950–53)

Paul B. Sears, Yale University (1951–54)

Laurence H. Snyder, University of Oklahoma (1952–55)

Warren Weaver, Rockefeller Foundation (1953–55)

Howard A. Meyerhoff (ex officio), AAAS

William E. Wrather (ex officio), U.S. Geological Survey

PUTTING SCIENCE TOGETHER

THE annual meeting of the Association has the reputation of being the biggest scientific show on earth. In respect to size this is not so, but from several other standpoints the AAAS may as well modestly admit it. No other scientific event brings the accomplishments of scientific research so forcibly to public attention, thanks to thorough and brilliant coverage by the science writers of the country. No other meeting brings so many experts in diverse fields together to explore the fertile areas in which disciplines meet and overlap. In no other convention do so many organizations cooperate in the exploitation of collective experience. The phrase that captured popular fancy in the Association's Arden House statement of policy—"to put science back together again"—is merely a description of what has been going on in a quiet way for several years.

The annual meeting overshadows other AAAS-sponsored meetings, but the others may appropriately be mentioned. It will be evident that the Association gets around, not only in this country, but abroad, for last year it was officially represented at meetings in every continent except Asia.

In May the Southwestern Division met with the Colorado-Wyoming Academy of Science at Boulder, Colorado, and 457 scientists in the Rocky Mountains, Great Plains, and Intermountain states assembled to discuss regional, but by no means provincial, contributions to the advancement of science (SCIENCE, **116**, 135 [1952]). In June the

Pacific Division played host to 17 affiliated and associated organizations at Corvallis, Oregon (SCIENCE, **116**, 407 [1952]), and 1095 scientists, mostly from Western states and Canadian provinces, demonstrated a vigorous interest in, and prosecution of, scientific and technological research. From mid-June to early September, approximately 2000 specialists gathered in a succession of weekly Gordon Research Conferences at Colby Junior College, New London, New Hampshire, and at the New Hampton School, New Hampton, New Hampshire, to consider the new discoveries and new techniques in chemical and related fields. In September, the Association's sections on Engineering (M) and Geology (E) met with the Industrial Minerals Division, American Institute of Mining tnd Metallurgical Engineers, at the Centennial of Engineering in Chicago to consider the raw materials survey of the Chicago region, structural materials, and the recovery of ground water for industrial use. Also in September, at McKinley National Park, the Alaska Division sponsored the Third Alaskan Science Conference, bringing together more than 200 specialists who are systematizing and solving scientific problems indigenous to our northern territory.

The Association also has five active branches that carry on its work within restricted areas. The organization of the Alaska Division is unique in that it consists of three branches—Cook Inlet, Arctic, and Southeastern—each organized around a center or nucleus of scientific activity. Within the continental United States branches have not been regarded as an essential element in AAAS structure because of the work of state academies of science; yet the Lancaster (Pa.) Branch functions in a state with an active academy, bringing science and scientists to a community audience numbering 500–800. Only one other branch is currently active—Springfield (Mass.), which is operating in a section where state academies are scarce.

The Association has been officially represented at scores of other meetings and ceremonies. On some of these occasions the AAAS representative was an active participant—for example, Detlev W. Bronk gave the exchange lecture at the Belfast meeting of the BAAS in September. Enough has been said to indicate that the Association exerts a continent-wide influence in its meeting activities. From all indications this influence is destined to spread and to give American science integration and direction.

THE AAAS AT ST. LOUIS

The **Newcomb Cleveland Prize** (formerly the AAAS $1000 Prize) was awarded to A. M. Gleason for his paper on "Natural Coordinate Systems," given at a meeting of the American Mathematical Society in St. Louis, December 27. Dr. Gleason, 31 years old, is an assistant professor in the Department of Mathematics at Harvard University.

The **AAAS Council** paid tribute to the memory of two scientists who were long active in Association affairs. On December 30 the following minutes were passed unanimously by standing vote:

EDWIN GRANT CONKLIN
1863–1952

A leader in the biological sciences, Edwin Grant Conklin profoundly influenced zoologists and biological thought during his long and inspired career as a teacher at Princeton University. His influence went far beyond the classroom, extending to all American science through his activity in the American Association for the Advancement of Science, of which he was President in 1936, and to all American scholarship in his long continued and devoted work for the American Philosophical Society. His inspiration as a teacher, a leader, and a friend has been bequeathed to the many students who discovered either a career, or a philosophy of life, or both in his classroom.

FOREST RAY MOULTON
1872–1952

Astronomer and pioneer in the problematic fields of celestial mechanics and earth origin, Forest Ray Moulton was a scientist, teacher, and philosopher who, though bound by facts, brought a creative imagination to bear upon scientific thinking and upon the relations between science and society. As Administrative Secretary of the American Association for the Advancement of Science during 1937–49, he brought order and integration to one of the nation's oldest scientific societies and, through the Association, to all of American science.

Arnold M. Rose, of the Department of Sociology, University of Minnesota, was awarded the new AAAS $1000 prize in social science theory, which was established in 1951, but was given for the first time at the AAAS meeting in St. Louis last month. Stuart C. Dodd, director of the Washington Public Opinion Laboratory, University of Washington, received honorable mention. The prize was given to Dr. Rose for his paper "The Theory of Social Organization and Disorganization," on the basis of independent ratings of nearly 60 entries by three judges—George A. Lundberg, University of Washington; Kenneth H. Parsons, University of Wisconsin; and Sidney Ratner, Rutgers University. The competition will be continued in 1953, and announcement of the conditions for this year's prize will be published on or about March 6 in SCIENCE.

The **Theobald Smith Award in Medical Sciences,** consisting of $1000 and a bronze medal, was given to F. J. Dixon, of the Department of Pathology, University of Pittsburgh School of Medicine, for his paper entitled "The Dynamics of Immune Response." The award, which was established in 1936 by Eli Lilly & Company, was given for the eighth time this year. Only scientists under 35 years of age are eligible for the prize.